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Aquatics Resource Report

South Fork Tributary Habitat Enhancement Project

Salmon/Scott River Ranger District, Klamath National Forest, Siskiyou County, California

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Aquatics Resource Report

Introduction

The purpose of this report is to discuss the effects of the South Fork Tributary Habitat Enhancement Project on aquatic Threatened, Endangered and Candidate species listed for protection under the Endangered Species Act. Threatened, Endangered, and Candidate species proposed for listing are designated by the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) under authority of the Endangered Species Act (Act) of 1973, as amended. The Act requires federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of those species habitat. Additionally, Essential Fish Habitat (EFH) consultation occurs under the Magnuson-Stevens Fishery Conservation and Management Act.

This report will also discuss the effect of the project on aquatic Forest Service Sensitive and Management Indicator Species. Federal laws and direction applicable to Sensitive species include the National Forest Management Act (2000) and Forest Service Manual (USDA Forest Service 1995, FSM 2670). Sensitive species are classified at the Region level, and management indicator species by the Forest. The Klamath Land and Resource Management Plan (LRMP) directs the Forest to (1) “maintain or improve habitat for aquatic species, especially TE&S” and (2) “maintain suitable fish habitat that will support well distributed, viable populations of native and desirable non-native fish.” To this end, the Forest has adopted an aquatic conservation strategy, including the designation of buffered Riparian Reserves and Standards and Guidelines to maintain habitat for aquatic species (USFS 1995).

Methodology

Different sets of Threatened, Endangered, and Candidate species are managed by the FWS and NMFS. An FWS species list was obtained online from the agency IPaC portal website on December 13, 2016 (FWS 2016). A biological opinion from NMFS was received on May 26, 2016, which concluded formal consultation for activities in the California Department of Fish and Wildlife (CDFW) Fisheries Restoration Grants Program included under the five-year Regional General Permit (NMFS 2016). The California Natural Diversity Database was also used to compile the species list for analysis. Species considered as Forest Service Sensitive were compiled by the Forest Service Pacific Southwest Regional Office. These lists were used as a basis for determining which aquatic species were to be considered in this specialist report. See **Table 1** for a summary. Terrestrial and semi-aquatic species, including amphibians, are analyzed in the appropriate Wildlife reports.

The only Threatened or Endangered fish in the analysis area is the Southern Oregon/Northern California Coasts Coho salmon (*Oncorhynchus kisutch*), including Critical Habitat. Sensitive fish species for the Klamath National Forest in the Project are the Upper Klamath-Trinity Rivers Chinook (*Oncorhynchus tshawytscha*), Klamath Mountains Province steelhead (*Oncorhynchus mykiss*), Klamath River lamprey (*Entosphenus similis*), and Pacific lamprey (*Entosphenus tridentatus*). Both steelhead and resident rainbow trout (*Oncorhynchus mykiss*) are management indicator species in the Forest Plan. Additionally, Essential Fish Habitat designation is associated with Coho salmon and Chinook salmon. The NMFS has requested action agencies, including the Klamath National Forest (KNF), to consider project impacts on species preyed upon by ESA-listed killer whale (*Orcinus orca*) / i.e., Southern Resident Killer Whales (SRKW). For this project, the relevant species would be the three anadromous salmonids introduced for analysis. Since analyzed fish species have overlapping needs and habitat, the same Indicators are used to indicate effects to all analysis species. These Indicators are outlined in the following section.

Table 1. Summary of analysis species, including status of each.

Species		Endangered	Threatened	Forest Sensitive	MIS	Critical Habitat	Essential Fish Habitat
Salmonids							
Coho Salmon (Southern Oregon/Northern California Coasts)	*Oncorhynchus kisutch*		X			X	X
Chinook Salmon (Spring/Fall runs) (Upper Klamath-Trinity Rivers)	*Oncorhynchus tshawytscha*			X			X
Steelhead Trout (Klamath Mountains Province)	*Oncorhynchus mykiss*			X	X		
Rainbow Trout	*Oncorhynchus mykiss*				X		
Lamprey							
Pacific Lamprey	*Entosphenus tridentatus*			X			
Klamath River Lamprey	*Entosphenus similis*			X			
Mammals							
Killer Whale (Orca) (Southern Resident)	*Orcinus orca*	X				X	

The Project site was visited by Amy Fingerle (Aquatic Biologist – Independent Contractor) in December 2016 to examine aquatic resources potentially affected by proposed Project activities. In addition, site visits were conducted by Project Lead Melissa Van Scoyoc on 6/20/2016, 8/17/2016, and 8/18/2016.

Data sources used to determine historic/current anadromous and resident salmonid distribution and habitat condition included:

1. Forest GIS layers
2. CalFish on-line database
3. Habitat/fish presence surveys performed by Forest Service personnel or contractors

This information, as well as scientific literature, field review, Project watershed and geology reports, and best professional judgment, were the bases for evaluating impacts to aquatic resources in the Project area.

Information specific to the biological requirements of species under consideration in this document is found in **Appendix A**.

Analysis Indicators

The analysis of the potential effects to fish and their habitat is organized by direct and indirect effects and by effects to seventeen Indicators of anadromous fish habitat conditions (Table 6). The Indicators originate from the "Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area" (USDI, USDA, and NOAA 2004). Further discussion of Indicators is found in **Appendix B**. Effects of project elements to an Indicator may be neutral (no effect), discountable (extremely unlikely to occur), insignificant (effects are not able to be meaningfully measured, detected, or evaluated), or significant (effects able to be measured). Furthermore, effects may be either positive or negative. After the appropriate Indicators have been evaluated, the resulting information is used to determine overall effects on aquatic species, including Coho Critical Habitat and Essential Fish Habitat.

Although the methodology for effects analysis only technically applies to anadromous fish within the Project area (e.g., Coho, Chinook, and steelhead), it may also be used for resident rainbow trout to ensure a consistent assessment of fish species; indirect effects to anadromous fish will serve as a proxy for lamprey. Additionally, Indicators are used to assess the existing environment of anadromous systems, with each Indicator labeled as to if it is “Properly Functioning,” “Functioning-At-Risk,” or “Not Properly Functioning” for each stream (**Appendices B, C**).

Analysis Indicators and Locations Excluded From Further Analysis

The following Indicators are to be excluded from analysis because Project components will not affect anadromous/resident fish or their habitat:

Physical Barriers – There is a human-made barrier upon Knownothing Creek, which is within the Project area footprint. This barrier is a small, non-functional diversion dam. Knownothing Creek supports both anadromous species and resident rainbow trout, and the degree that the barrier inhibits free movement of fish is unknown. Removal or modification of this barrier for fish passage is outside the scope of this Project. There are no known barriers on Methodist Creek. No new barriers will be built upon either Project streams as a consequence of this Project.

Off-Channel Habitat – Little off-channel habitat is present within the Project area; where it is present, Project activities will not affect it.

Peak/Base Flows – The Equivalent Roaded Area (ERA) model shows no detectable disturbance between pre- and post-Project conditions; therefore, there would be no change in peak/base flows. See “Disturbance History/Regime” for further discussion.

Floodplain Connectivity – As peak/base flows are expected to maintain proper functioning, flow access to upper banks and inundation of floodplains will continue to occur at expected rates.

Drainage Network –There will be no building of new roads, ditches, or other impervious surfaces that may transport water. Temporary routes used by equipment to access individual large wood installation sites will not affect the existing hydrologic connectivity between the road system and the stream. Stability actions, if required, will occur following implementation. Further, the project will not affect the existing active stream channel length, which has been modified (i.e., shortened) from pre-settlement condition due to mining.

Road Density/Location – No new system roads will be constructed. Temporary access routes will be obscured, blocked from further use, stabilized, and, if necessary, re-seeded with native, certified weed-free seed, immediately following implementation and completed by November 1st.

Summary of Analysis Indicators and Locations Retained for Analysis

Indicators

The following Indicators are potentially affected by the Project and will undergo further discussion:

- Temperature
- Turbidity
- Sediment/Substrate
- Chemical/Nutrient Contamination
- Large Woody Debris
- Pool Frequency and Quality
- Refugia
- Width/Depth Ratio
- Streambank Condition
- Disturbance History/Regime
- Riparian Reserves

7th-Field Watershed Scale

Lower Knownothing Creek – Knownothing Creek

Knownothing Creek is the principle stream of this 7th-field watershed within the Project area. Coho, Chinook, steelhead, and rainbow trout are found in Knownothing Creek, and the potential exists for lamprey spawning habitat. Additionally, the confluence area of Knownothing Creek is a thermal refugia for SF Salmon River salmonids.

Methodist Creek – Methodist Creek

Methodist Creek is the principle stream of this 7th-field watershed within the Project area. Coho, Chinook, steelhead, and rainbow trout are found in Methodist Creek, and the potential exists for lamprey spawning habitat. Additionally, the confluence area of Methodist Creek is a thermal refugia for SF Salmon River salmonids.

5th-Field Watershed Scale

South Fork Salmon River

All fish species of interest – Coho, Chinook, steelhead, rainbow trout, lamprey – are present in SF Salmon River. This scale considers impacts on a large landscape scale, as well as potential direct/indirect effects to the mainstem system from Project activities.

Measures (for Analysis Indicators)

Temperature

This Indicator is rated by stream temperature and the expected increase/decrease from the existing condition due to Project activities in fish-bearing reaches of stream channels (**Appendices B, C**).

Turbidity

This Indicator is rated by professional judgment following observation of conditions after high water events, amount of substrate fines, CWE models (USLE/GEO), and condition of Riparian Reserves (**Appendices B, C**). In addition, the distance to fish habitat and the likelihood of activities to introduce fine sediment into fish-bearing streams will also be incorporated into the effects analysis.

Turbidity describes suspended sediment in the water column. It is generally composed of very small particles like silts because larger material is difficult to keep suspended except at high flows (Swanston 1991). Because a degree of turbidity is natural in stream systems, often observed during spring run-off and storm events, fish are adapted to it (Bjornn and Reiser 1991). Outside the laboratory environment, chronic and elevated levels of turbidity considered detrimental to aquatic organisms only occur following catastrophic natural incidents such as large landslides or extensive wildfires, or where human activities provide an extensive raw surface available for continuous stream erosion (Meehan 1991; Neary *et al.* 2008).

Sediment/Substrate

This Indicator is rated by percentage of substrate composition of finer material. Considered data can include composition of surface and subsurface of non-pool units, as well as volume of pools filled with fines. Where no or limited survey data is available, evaluation may utilize CWE (USLE/GEO) models and professional judgment (**Appendices B, C**).

Sediment in streams is a part of the natural geological process. Certain erosive geologies, such as granitic soils, can impart a high amount of fines to a stream system even from Wilderness locales. It is when management activities upon the landscape increase incoming sediment flux within a drainage such that it is higher than normal background processes that human-induced impact to aquatic resources begin to occur. Depending upon the scale considered, effects may be highly localized (e.g., at the confluence of two streams) or more diffuse (e.g., multiple miles of increased spawning bed embeddedness).

Chemical Contamination and Nutrients

This Indicator is rated by the level of chemical and/or nutrient enhancement contamination from agriculture, industrial, and other sources (**Appendices B, C**).

Large Woody Debris

This Indicator is rated using amount of "large wood" per linear length of stream and is only applicable in 3rd or larger order stream systems (**Appendices B, C**). The Northwest Forest Plan and KNF Land Resource Management

Plan (page #4-143) offer guidelines as to an acceptable amount of wood, as well as provide definitions of "large wood." If professional judgment concludes guidelines are inadequate or do not capture the nature of the system under consideration, channel width and potential of the site to produce and retain woody debris may be used. Potential for future large woody debris recruitment in both short- and long-term should also be included in rating the Indicator. Recruitment effects will be determined using the likelihood of the removal of standing trees that have a high probability of becoming large woody debris in the stream channel based on professional judgment and scientific literature.

Pool Frequency and Quality

This Indicator is rated by frequency and quality of pools present in a stream system (**Appendix B, C**).

Refugia

This Indicator is a synthesis of presence and degree of functionality of habitat elements available for fish throughout their life history. Considerations for rating include stream temperature, water quality, riparian reserve, water flow, sediment in pools, and connectivity (**Appendices B, C**).

Width/Depth Ratio

This Indicator is rated by width-to-depth ratio, in relationship to Rosgen stream type, and amount of braiding due to sediment aggradation. If data are limited or lacking, other considerations may include drainage history of debris flows and mass wasting, pool frequency and depth, frequency of large woody debris, and CWE models (**Appendices B, C**).

Streambank Condition

This Indicator is rated bank stability of a stream system. If data are limited or not available, considerations may include density of road-stream crossings, amount of inner gorge road, type and amount of non-road areas of compaction near the stream, presence of artificial berms, and extent of recent debris flows (**Appendices B, C**).

Disturbance History/Regime

This Indicator is primarily rated using CWE (ERA/USLE/GEO) models. If professional judgment concludes that these models are not fully capturing disturbance risk, road density and location, current impacts from past stand-replacing timber harvest and wildfire, fire regime, vegetation regime, and development on private property may also be considered (**Appendices B, C**).

The ERA, USLE, and GEO models track various aspects of human and natural impacts upon the landscape and geologic environment. ERA ("Equivalent Roaded Area") provides an accounting system for tracking disturbances that affect watershed processes, in particular changes in peak runoff flows influenced by ground disturbing activities; USLE ("Universal Soil Loss Equation") tracks surface erosion and sediment delivery in the first year following project completion; and GEO estimates sediment delivery from mass wasting (i.e., landslide events) for the first decade after project completion. A threshold of "1" generally indicates an elevated risk of impact from a given model. This is not the point at which significant effects occur, but a yellow flag indicating that additional impacts need to be considered for resource degradation.

Riparian Reserves

This Indicator is a consideration of the riparian environs, and extending into the near uplands. It is rated as a synthesis of shade; large woody debris recruitment; disturbance, roading, and other impacts to the Riparian Reserve management zone (**Appendices B, C**).

Spatial and Temporal Bounding of Analysis Area

The analysis area for aquatic resources includes effects at the site-specific and watershed-scale extent.

Watersheds utilized in the analysis are at the 5th- and 7th-field level. Site-specific analysis discussion will focus on the placement of instream habitat structures (i.e., large diameter logs and constructed woven log jams) within the range of anadromous and resident fish.

Temporal analysis timeframe includes effects during implementation, short-term effects expected to occur within the first year following implementation, and long-term effects (greater than one year).

Affected Environment

The Project encompasses multiple large woody debris structures in Knownothing and Methodist Creeks, intermittently extending over 3.2 miles of stream (1.4 miles and 1.7 miles respectively), within the South Fork Salmon River watershed (**Map 1**). The entire project area is located on Klamath National Forest lands. Knownothing Creek is about 3 miles upriver from the town of Forks of Salmon, California, in Siskiyou County; Methodist Creek is about 6 miles upriver from Forks of Salmon.

The Project will occur within the following 5th-field and 7th-field watersheds:

- South Fork Salmon River: 1801021001
    - Lower Knownothing Creek: 18010210010701
    - Methodist Creek: 180102100108

The legal description for the Knownothing Creek sites is Township (T) 10 North (N), Range (R) 8 East (E), Sections 29-31 (Humboldt Meridian); and for the Methodist Creek sites it is T 39N, R 12W, Sections 30 and 31 and T 38N, R 12W, Section 6 (Mt. Diablo Meridian).

The upper and middle watershed topography in Knownothing and Methodist Creeks is located in steep, mountainous terrain with hillslope gradients frequently exceeding 70% along inner gorges, headwalls, and upper hillslope positions. The lower reaches of the watersheds (where the proposed project occurs) are characterized by lower gradient, simplified stream channels. The lower reaches of the watersheds flow over a low gradient, broad alluvial fan/river terrace complex that is naturally prone to channel deposition and shifting alignments. However, both streams have been channelized to a greater or lesser degree, likely due to historic mining activity. As recently as 1950, Knownothing and Methodist Creeks flowed across the entire floodplain, utilizing the entire channel capacity and discrete side channels (see Water Quality Report). Therefore, there is a possibility that during an extreme storm event the active streams could utilize their floodplains and develop a more complex channel alignment.

At various locations in the watersheds, ancient terrace deposits as well as older erosion surfaces are preserved. The older river terraces occur up to several hundred feet upslope of the present channel, more recent terrace deposits occur near the active channel of the stream and consist of sand, gravel, and boulder deposits (de la Fuente and Haessig 1994). Both creeks were disturbed by historic placer mining, which has left behind a mix of natural and man-made landforms including placer tailing piles strewn throughout the natural floodplain terraces adjacent to the active channel(s). Additionally, the streams have an abundance of boulders not suitable for spawning; most of the fine sediment and cobble have been transported out of the stream into the South Fork Salmon River.

Knownothing and Methodist Creeks have degraded habitat complexity as a result of historic unrestricted stream clearing, logging, and mining. Logging that occurred from the 1950s – 1980s resulted in the removal of most of the large conifers from the creeks. Large woody debris was also pulled out of these tributaries during the 1980s. Taken together, these historic and more recent efforts have resulted in a broad-scale simplification of channel complexity and a corresponding reduction of suitable habitat for all life stages of salmonids. The landscape at the watershed-scale shows that recovery has been sometimes very slow due to local conditions and nutrient deficient soils. An instream structure assessment completed by the SRRC in Knownothing and Methodist Creeks in 2014 showed an overall lack of large diameter wood instream structures and the resulting habitat complexity required for successful spawning and rearing for Coho salmon and other salmonids. Additionally, the reach of the South Fork Salmon where these creeks drain into was identified as high priority reach for riparian restoration (SRRC 2008).

The Project comprises less than 1.5 acres in riparian areas, though the footprints of individual structures are very small. Both creeks are deficient in complex channel habitat associated with naturally occurring large diameter wood accumulations, which results in high velocity, shallow, entrenched, channelized streams that are relatively stable in their current flow paths. The creeks flush water, sediment, organic material, and wood too quickly through the system, resulting in limited connection of flows within the floodplain. This lack of floodplain inundation and hyporheic flow limits shade creating riparian vegetation, resulting in unnaturally high stream temperatures. Additionally, the scarcity of wood structures results in a lack of cool water pools, cover, and food source features for juveniles salmonids, as well as the loss of spawning size gravel as it is flushed out of the system.

Appendix A includes specifics in regards to biology of analysis species, as well as survey records and distribution in the Project streams. **Table 2** summarizes actual and potential occupancy by analysis species in Knownothing and Methodist Creeks and the SF Salmon River.

Table 2. Summary of actual and potential occupancy by analysis species of creeks/rivers within 7th- and 5th-field watersheds.

Species	7th-Field		5th-Field
	Knownothing Creek	Methodist Creek	SF Salmon River
Coho	X	X	X
Chinook	X	X	X
Steelhead	X	X	X
Resident Rainbow Trout	X	X	X
Pacific Lamprey			X
Klamath River Lamprey			P

X - confirmed present
P - potential presence

- Lamprey species – Pacific lamprey are confirmed to be present in the Salmon River drainage via the Karuk rotary screw trap at the mouth of the mainstem, and elsewhere by direct observation. Larval lamprey, which could be Pacific or Klamath River lamprey, have been found as far upstream SF Salmon River as above the confluence with East Fork. Knownothing and Methodist Creeks do not appear to provide appropriate rearing habitat for lamprey, although spawning may be present. See **Appendix B** for additional information on lamprey within the Project area.

--Existing Conditions – Analysis Indicators--

Only Indicators potentially affected by the Project and, therefore, introduced in the "Methodology" section, are further discussed here prior to analysis within "Environmental Consequences." Indicators are generally applied only to anadromous systems. A summary of all discussed Indicators is presented in **Table 6**. See **Appendix C** for a list of remaining Indicators and their relationship to baseline conditions.

Temperature

The SF Salmon River (including the Project area) is 303(d) listed under the Clean Water Act as impaired for water temperature. Water temperature on the mainstem of the South Fork is recognized to be a limiting factor to salmonid production in this portion of the watershed. Within the project area, recent stream temperature data is available for Knownothing Creek, Methodist Creek, and SF Salmon River.

Knownothing Creek and **Methodist Creek** have fish habitat, including Coho Critical Habitat, within Project boundaries. While stream temperature monitoring has occurred since 1990, the most recent focus since 2010 has been for water quality monitoring. Depending on water-year and the resultant interannual variability, the creeks can range from "Properly Functioning" to "Not Properly Functioning (USFS 2012; unpub. data [KNF, SRRC]). Taking the entire dataset into account, the creeks are probably best described to be "Functioning-At-Risk" under the AP framework.

SF Salmon River typically has elevated summer water temperatures due to cumulative impacts of historic mining, flood scour, and other factors. The SF Salmon River is "Not Properly Functioning" under the AP framework. During the warm summer months when water temperatures in the SF Salmon River approach 20°C, anadromous and resident fish rely upon cooler water habitat within tributary creeks and their confluence zones (thermal refugia), as well as upwelling from subsurface (hyporheic) flows. Both Knownothing Creek and Methodist Creek are considered to be thermal refugia.

Turbidity

Little to no quantitative turbidity data exist for streams on the Klamath National Forest. However, modeling of soil loss and risk of mass wasting in the CWE analysis (**Table 4**) is well under the threshold of concern and sediment composition, especially the finest elements (<2 mm), appears to generally be within desired parameters for both creeks (see "Sediment/Substrate" Indicator discussion). Therefore, turbidity within the Project area for **Knownothing** and **Methodist Creeks** can be considered "Properly Functioning."

SF Salmon River turbidity is likely "Functioning-at-Risk." Although recent substrate data is not available, information from the 1990s indicate that the river includes an elevated percentage of sand and silt, especially in its lower reaches (USFS 1994, 1997, 1998; unpub. data). This type of material is easily mobilized to the water column to create turbid conditions. Furthermore, the 1997 Watershed Assessment specifically indicates the propensity of the lower SF Salmon River for turbid conditions, especially following large events such as fire or landsliding (USFS 1997). The demonstration of the SF Salmon River to become notably muddy continues to the present: in December 2014, following winter storm events, the river was seen to be very dark, likely due to landsliding somewhere in the basin (mainstem or tributary) upstream of the Forest Service Petersburg Guard Station (KNF District Fish Biologist, Maija Meneks, pers. obs.; **Photo 1**). In general, turbidity has been observed to require multiple days to clear to its normal baseline following high water events.

Photo 1. Confluence of the South Fork (left) and North Fork (right) Salmon Rivers, December 2014. The SF Salmon River can exhibit elevated turbidity following a storm event.

Sediment/Substrate

Knownothing Creek is considered to be "Properly Functioning" for the substrate character Indicator. Sediment monitoring data from 2011 and 2014 show that sediment indicators for Knownothing Creek are less than reference conditions, which means that the creek is attaining desired conditions for in-stream fine sediment (USFS 2016). Older habitat survey data that includes substrate components – 1989, 1998 – also support this assessment, as does sediment monitoring which occurred 1990 to 1992. As well, CWE modeling for mass-wasting (GEO) and surface erosion (USLE) in Lower Knownothing Creek are below the "1" threshold.

Methodist Creek is considered to be "Functioning-At-Risk" for the substrate character Indicator. Although CWE modeling for mass-wasting (GEO) and surface erosion (USLE) in Methodist Creek are below the "1" threshold, sediment monitoring data from 2014 showed the subsurface sediment indicator (<6.38 mm) to exceed the reference condition in 2014. Other sediment indicators (surface [<2 mm] and subsurface [<0.85 mm]) met desired conditions in both sample years of 2011 and 2014 (USFS 2016). Therefore, because direct data suggest that the Sediment/Substrate Indicator is on the edge of properly functioning – as opposed to indirect CWE measures, which support "Properly Functioning" characterization – the conservative rating is "Functioning-At-Risk." Older sediment monitoring which occurred 1990 to 1992 supports this assessment with a between-year variability that may (or may not) meet desired conditions.

SF Salmon River is best characterized as "Functioning-at-Risk." No recent substrate data is available for the SF Salmon River mainstem. However, data were collected at multiple locations in the 1990s, from mouth to headwaters. Original data and summarized datasets show a wide range of variability, with finer substrates and greater embeddedness values present lower river reaches compared to higher, including Wilderness (USFS 1994, 1997, 1998; unpub. data). In general, the Coho Recovery Plan for the Salmon River drainage did not find sediment delivery to be a significant stress to fish, with little accumulation of fine substrates in pools and channels (NOAA 2014). However, the document also noted that sediment loading to continue to be elevated in some areas, which could cause localized effects.

Chemical Contamination and Nutrients

No specific water quality data exist for **Knownothing** and **Methodist Creeks** in regards to chemical contamination or nutrients. The effects of human activities, including ongoing mining operations, within the drainages are minimal and no point sources of nutrient enrichment or chemical contamination are known. Knownothing and Methodist Creeks are therefore considered to be “Properly Functioning” for this Indicator.

The **SF Salmon River** has no known sources of nutrient enrichment or chemical contamination. Additionally, the SF Salmon River does not have any 303(d) listings under the Clean Water Act for either chemical or nutrient elements. The SF Salmon River (and its tributaries) is therefore considered "Properly Functioning".

Large Woody Debris

All waterways in the Project area – **Knownothing Creek**, **Methodist Creek**, and **SF Salmon River** – are “Not Properly Functioning” for large woody debris. Both recent and past surveys in the Project area which included a large woody debris component found instream wood, as well as potential future recruitment, to not be at desirable levels (USFS 1997, 1998; SRRC unpub. data). The lack of large woody debris, and the subsequent detrimental effect to fish habitat, including Coho Critical Habitat, has been repeatedly identified to be of concern (USFS 1997; NOAA 2014). The reason behind the lack of desirable amounts of large woody debris is multifaceted, and has been attributed to a combination of timber harvest, mining, altered fire regime, historic “cleaning” (removal) of wood from stream channels, and scour from large flood events.

Pool Frequency and Quality

No recent data exist for **Knownothing** and **Methodist Creeks**. Older habitat surveys conducted in Knownothing Creek (1989, 1998) and Methodist Creek (1988, 1989, 1992) indicate an overall general lack of pools of the quality and quantity considered to be desirable. As there have been no change over the years by the streams which would substantially alter pool development or enhancement processes, it is likely both creeks are best considered to be “Not Properly Functioning” for this Indicator.

No recent comprehensive habitat surveys have been completed on the **SF Salmon River**. However, data were collected at multiple locations in the 1990s, from mouth to headwaters. Original data and summarized datasets show a wide range of pool frequencies dependent upon Rosgen channel type, substrate composition, and degree of stream confinement; and that primary pools (i.e., greater than 36 inches) are common (USFS 1994, 1997, 1998; unpub. data). Overall, the best description of the mainstem SF Salmon River appears to be “Functioning-at-Risk."

Refugia

The determination of existing condition for refugia is a synthesis of presence and degree of functionality of habitat elements available for fish throughout their life history and in both summer and winter. **Knownothing** and **Methodist Creeks** are considered to be “Functioning-At-Risk” because of limitations which affect the ability of habitat to support fish within the Project area, including a lack of quality pools and instream large woody debris. However, the creeks do provide adequate biological connectivity, although some accessibility issues, dependent upon discharge condition and fish life stage, may occur on Knownothing Creek due to the non-functional dam structure. Causes for the existing condition of the refugia Indicator are linked to both anthropogenic (e.g., historic mining and timber harvest; current roading) and natural (e.g., wildfire, flood) sources. See individual Indicator subsections for detailed discussion, as well as **Appendix C**.

The **SF Salmon River** is considered to be “Properly Functional” for refugia. While there are multiple subcomponent Indicators which do not exhibit optimal condition, the river has demonstrated functional habitat elements to support fish throughout their life history. Decades of surveys, with a focus on analysis salmonid species, have observed aspects of spawning, rearing, and migration, as well the utilization of habitat by fish for each component of their respective life histories.

Width/Depth Ratio

Knownothing and **Methodist Creeks** are considered to be "Properly Functioning" under the AP framework. A stream channel assessment in 2014 found Knownothing and Methodist Creeks to be best described as having a Rosgen “B” type channel within the survey area (SRRC unpub. data), with eight of nine reaches surveyed having a measured bankfull width/depth ratio that met "Properly Functioning" (i.e., > 12). Older survey data that includes elements of width/depth ratio support this assessment (Knownothing Creek – 1989, 1998; Methodist Creek – no data). As well, CWE modeling for mass wasting (GEO) and surface erosion (USLE) are below the "1" threshold.

No specific data are available for **SF Salmon River** in regards to the width/depth ratio Indicator. Of the available supplementary information which can be used in analysis of this Indicator, applicable CWE models are under threshold, stream crossing density is low, and there are few mass wasting events caused by *management* actions. Although pool frequency is not optimal, pool quality is very good, with the majority of pools able to be classified as "primary" (i.e., greater than 36 inches deep) (see "Pool Frequency and Quality" subsection). Large woody debris is not adequate. However, in a system the size and power of the SF Salmon River, it is debatable if debris would have a more than localized impact, even if present, because high water events are expected to regularly mobilize wood. If wood cannot have long-term stability, its effect upon an Indicator such as width/depth ratio is likely to be minimal. Sediment character is also not optimal, especially in the lower SF Salmon River, but it does not appear to be impacting the width/depth ratio due to the spring run-off discharge mobilizing the bedload on an annual basis. Overall, the best characterization of the mainstem SF Salmon River appears to be "Properly Functioning."

Streambank Condition

No recent data in regards to the streambank condition Indicator are available for **Knownothing** and **Methodist Creeks.** The 1997 Ecosystem Analysis for the lower SF Salmon River rates Knownothing and Methodist Creeks as having moderate channel stability (USFS 1997). Bedrock and boulders provide for good bank stability, with the caveat that these types of substrate may be what has been left following a history of flood scour and historic mining removing the smaller, more mobile particles. The presence of alder and other vegetation also add to bank stability. Overall, streambank condition for Knownothing and Methodist Creeks best fits the "Functioning-at-Risk" category: the existing condition is one of good stability, but the streambanks have been compromised from the pre-settlement state due to human-mediated impacts, including channelization, presence of tailing piles, and other legacy mining effects.

The streambank condition for **SF Salmon River** is likely "Properly Functioning" when considered on the scale of the 5th-field watershed. No specific data are available for this Indicator. The SF Salmon River is not a pristine system, and there are multiple examples of historic large-scale modification from mining in the form of dredge piles, impacted bars, and berms which do cause a localized effect to the streambank. However, there are also extensive areas of no or minimal impact, such as bedrock canyon reaches which were not conducive to mining and the Wilderness where processes are presumed to represent the natural condition. Direct impact to river banks by roads is low: overall crossings are relatively few, and the County Road tends to be located high on the side of the canyon and/or away from the river where it cannot affect the stream channel. Personal observation by the District Fish Biologist indicates streambanks to consist largely of bedrock, boulders, or large cobbles: the Salmon River system is naturally a high-energy system, and high flows are a common occurrence, mobilizing smaller substrates from the margins, especially where historic flood scour (e.g., 1964) removed trees and normal high water events preclude establishment of woody vegetation. Alders and willows can be thick in places, holding to finer substrates and assisting in streambank maintenance. There is minor raveling and sliding affecting streambanks, but those locales appear to be a natural occurrence.

Disturbance History and Regime

A "Properly Functioning" disturbance regime includes stable natural processes and hydrograph, where high quality habitat and watershed complexity provides refuge and rearing for all life stages or multiple life-history forms; and all three cumulative watershed models should be below the "1" threshold. This description fits all 5th-field and 7th-field watersheds within the Project area (**Table 3**). Alternately, a "Functioning-at-Risk" disturbance regime, the frequency, duration, and magnitude of disturbance events have the potential to be moderately departed from the reference condition due to human-mediated impacts upon the watershed; and one or two of the models may be over threshold. Finally, a "Not Properly Functioning" disturbance regime is described as a watershed with disturbance events significantly departed from reference condition as a consequence of past/current human activities; and all three models are over threshold.

In the case of the drainages in the Project area, consideration must go beyond the cumulative watershed effects models. Knownothing Creek and Methodist Creek 7th-field watersheds have been greatly modified by past and current human actions. The combination of historic logging and lack of wildfire within the watershed has resulted in altered vegetation throughout the watersheds. Within the riparian area, changes in forest vegetation has decreased the large wood recruitment potential of the streams. Furthermore, large woody debris were moved from these tributaries during the 1980s. Hydraulic and placer mining has altered natural flow patterns throughout the floodplains of the creeks, channelizing the streams. The general area continues to be affected by small-scale mining (i.e., panning, sluicing, dredging [not currently allowed]). The mining-era town of Yoakumville [Yocumville] was located across from the mouth of Methodist Creek; and in the Knownothing Creek drainage on the hillslope above the West Fork/East Fork confluence could be found Gilta. Additional private residences are present at the mouth of Knownothing Creek. Finally, both Knownothing and Methodist Creeks have roads that parallel their respective mainstems through the Project area, in many places coming less than 100 feet from the stream.

Due to extensive post-settlement alteration of the drainages, these creeks are probably best described to be "Functioning-at-Risk" despite CWE model guidance.

See **Appendix B** for additional information in regards to baseline Indicator determination.

Table 3. Existing baseline conditions as assessed by the three cumulative watershed effects models.

Watershed	Square miles	ERA Risk	USLE Risk	GEO Risk
7th-Field Watershed				
Lower Knownothing Creek	2.6	0.31	0.33	0.50
Methodist Creek	12.7	0.25	0.29	0.34
5th-Field Watershed				
SF Salmon River	290	0.31	0.26	0.40

Riparian Reserves

Knownothing and **Methodist Creeks** are characterized to be "Functioning-at-Risk." Knownothing Creek has a human-caused shade loss of 0.1%, which has an undetectable effect on stream temperatures at the watershed scale, whereas Methodist Creek shows an alteration of the natural stream shade at 1.1% human-caused shade loss (USFS 2012). The caveat with the Riparian Reserve Indicator is that other considerations than shade must be taken into account. A combination of historic timber harvest, altered fire regime, flood events, and other natural/anthropogenic events have potentially affected the Riparian Reserves of the Salmon River drainage in a detrimental manner (USFS 1997; NOAA 2014). The Lower SF Salmon River Watershed Assessment mentions general impacts to Knownothing and Methodist Creeks in regards to a 1987 stand-replacing wildfire which affected riparian vegetation (although Knownothing Creek lost relatively little vegetation), as well as scour from the 1997 flood event (USFS 1997). At the time of the document, recovery through the early-seral stage was ongoing in regards to the wildfire and that vegetation had returned landsliding risk to its pre-1987 values. Knownothing and Methodist Creeks were not specifically addressed in the 2014 Coho Recovery Plan, but they likely meet the same conditions as described for the mainstem and forks, with generalized impacts to the riparian forest expected in regards to roading and historic mining (NOAA 2014). Recovery of the Riparian Reserve in the Project area is continuing and is a long-term process.

The **SF Salmon River** is "Functioning-at-Risk." The Coho Recovery Plan lists "degraded riparian forests" as a primary stressor in the Salmon River drainage (NOAA 2014). Lack of riparian cover along areas of the SF Salmon River was specifically highlighted to be of concern. Mining and an altered fire regime – increased understory fuel loading – due to timber extraction and long-term fire-suppression practices are described as human-mediated impacts affecting riparian forests. Natural disturbances include flood scour (particularly from the 1964 event), fire, and mass wasting events. The 1997 Watershed Assessment for lower SF Salmon River suggests that the riparian in the general Project area are in decent to good state, but that more improvement is necessary to fully meet desired condition (USFS 1997).

Table 4. Baseline for analysis Indicators for streams in the Project area.

Stream/River	**Temperature**	**Turbidity**	**Sediment/Substrate**	**Chemical/Nutrients**	**Large Woody Debris**	**Pool Frequency/Quality**	**Refugia**	**Width/Depth Ratio**	**Streambank Condition**	**Dist. History/Regime**	**Riparian Reserves**
Knownothing Creek	FAR	P	P	P	NF	NF	FAR	P	FAR	FAR	FAR
Methodist Creek	FAR	P	FAR	P	NF	NF	FAR	P	FAR	FAR	FAR
SF Salmon River	NF	FAR	FAR	P	NF	FAR	P	P	P	FAR	FAR

P - "Properly Functioning"
FAR - "Functioning-at-Risk"
NF - "Not Properly Functioning"

Environmental Consequences

Alternative 1 – No Action

Direct Effects and Indirect Effects

Under the No Action alternative, no treatments as proposed will be implemented. Knownothing and Methodist Creeks will continue to exhibit degraded habitat complexity due to an overall lack of large diameter instream wood. Without such structures, the channels will maintain shallow flows with poorly sorted gravels, a paucity of cover, and decreased substrate for insect food sources for salmonids. Pool and other slow water habitat will not be increased; during high discharge flushing events, the creeks will persist in excessive transportation of sediment, spawning gravels, and large woody debris downstream into the SF Salmon River. See **Table 3** for baseline CWE models within the analysis area. In summary, Knownothing and Methodist Creeks will continue to have degraded fish and riparian habitat as well as decreased water quality, and will not meet Forest Plan Aquatic Conservation Strategy Objectives.

Cumulative Effects

There will be no cumulative adverse impacts to fisheries resources from the No Action Alternative. Past and ongoing events within or adjacent to the Project area are considered to be part of the existing condition.

Future foreseeable actions planned or ongoing at the time of this document include Discovery Day Mine, Hotelling Gulch Fish Passage and Channel Restoration, Knownothing Fuels Reduction, and active mining (placer) claims along the SF Salmon River and Knownothing Creek (see “Alternative 2” subsection for summarized descriptions). All these projects/activities share a 7^{th}-field and/or 5^{th}-field watershed with the SF Tributary Enhancement Project, but most are spatially distinct in regards to active footprint. An exception may be placer claims along Knownothing Creek, where activity could occur at or adjacent to structure placement sites.

Cumulative impact occurs when the effect of one project overlaps with or compounds the effects of another. The South Fork Tributary Enhancement Project does not influence the implementation of any nearby project, nor visa-versa. Therefore, without direct effects or a compounding indirect effect, there cannot be cumulative effects for the No Action Alternative.

Alternative 2 – Proposed Action

Direct Effects

Direct effects to Coho salmon, Forest Service Sensitive species, and management indicator species and their habitat may occur as a result of habitat structure installation in the stream channels of Knownothing and Methodist Creeks.

Instream activities can mobilize suspended sediment to downstream aquatic habitat. These activities will include structure installation (including site preparation) and equipment crossings. Suspended sediment increases turbidity, exposing juvenile fish to gill damage and reduced oxygen uptake, and/or reduced vision and compromised feeding effectiveness. If structure installation sites were to occur with eggs present in adjacent redds, deposition of suspended sediment could fill interstices of stream bottom substrate, depriving incubating eggs of dissolved oxygen and resulting in their mortality.

None of the structures are located in association with thermal refugia. Dewatering the work sites would result in a greater disturbance to fish and fish habitat than will be caused by constructing the structures. Therefore, the sites will not be dewatered and fish relocation will not occur.

There is a very low probability of direct impact to fish because both Knownothing and Methodist Creek has sufficient room for adults and juveniles to distance themselves project activities. Prior to working at each site an individual will precede the equipment on foot to displace aquatic species and prevent them from being injured. It is anticipated that fish temporarily avoiding installation sites are not likely to experience a significant reduction in feeding success, nor result in a significantly higher probability of exposure to predators. Sites will be implemented sequentially, not simultaneously, which means that only a small portion of a given Project stream will be affected at any one time. Additionally, effects are only anticipated during actual instream operations. See the South Fork Tributary Enhancement Project EA for a full list of Project Best Management Practices/Project Design Features meant to reduce impact to fish and fish habitat during implementation. By considering the mobility of fish in the creeks and the limited area of work to be undertaken at each site, there are likely to be only minor, insignificant direct effects on anadromous and resident fish, including habitat, with no long-term effects.

Indirect Effects

--Salmonids--

Temperature

Knownothing and **Methodist Creeks** could experience an insignificant increase in stream temperature if streamside vegetation removal results in reduction in effective stream shade. However, tree removal for equipment access and operation and site preparation/structure installation is expected to result in minimal canopy shade loss over the streams. In riparian areas, a total of 15 white alders will be removed, all less than 12-inches diameter at breast height (DBH). Due to the minimal extent of vegetation removal, any detrimental impact to stream temperature will be localized and minor, and very likely indiscernible from natural variation. Thermal refugia at the mouth of both creeks are too far from structure sites, and volume of streams too large, to be affected. Residual effects will diminish within two to three years as riparian vegetation re-establishes and grows large enough to provide effective stream shade.

Long-term, the Project is expected to have a slight beneficial effect on Knownothing and Methodist Creek stream temperature (see Water Quality Report). This will occur because large wood structures store sediments and create streambed complexity, which in turn increase hyporheic flow, potentially creating localized but biologically valuable thermal refuge (Poole and Berman 2001; Sawyer and Cardenas 2012). The magnitude of this effect will be insignificant; it will not be discernible from normal background variation on the reach level, but it is expected to provide a localized benefit for fish.

There will be no effect in temperature to **SF Salmon River**. Because no trees will be removed adjacent to the river, there will be no change in shade and, therefore, no change in temperature.

Turbidity and Substrate/Sediment

Because turbidity and substrate/sediment Indicators are similar facets of a larger sediment component, they will be discussed together.

The Project could impact turbidity and substrate/sediment Indicator values in **Knownothing** and **Methodist Creeks** due to ground-disturbing work that will occur throughout the Project footprint. Disturbance that will occur within the annual floodplain (areas annually disturbed by high flows) is approximately 0.30 acres and 450 linear feet along the stream channel. This is compared to a cumulative Project stream length of 3.2 miles. Additional disturbance within the Project footprint includes temporary access routes, which are approximately 1,025 linear feet (0.35 acres) within riparian areas and 2,050 linear feet (0.70 acres) in upland areas. Access routes will be stabilized, if necessary, immediately following implementation and completed by November 1st.

Instream activities produce both short- and long-term effects in regards to turbidity/suspended sediment production. A conceptual model includes two main phases: (1) a pulse of suspended sediment associated with construction activities, and (2) continued erosion of fine particles from disturbed banks until such time that vegetation stabilizes the soil (Sear et al. 1998). The initial suspended sediment release is expected to be short-term, with the amount of suspended sediment rapidly dropping to pre-construction levels both in time and space (Sear et al. 1998; Madej 2001; Brown 2002; Foltz and Yanosek 2005). For example, a study commissioned by the Environmental Protection Agency found that turbidity caused by instream suction dredging returned to acceptable water quality levels within 250 feet; and no discernible turbidity release occurred when dredges were not operating (Royer, *et al*. 1999); and the KNF programmatic Facilities Maintenance and Watershed Restoration Biological Assessment included consultation upon minor instream activities such as culvert replacement, determining that turbidity was undetectable beyond a distance of 300 feet (USFS 2004). Most erosion occurs in the first few high water events following channel work, with long-term stabilization occurring once appropriate vegetation grows (Sear et al. 1998; Madej 2001). However, residual increases over background may remain due to erosion of exposed surfaces and resuspension of settled matter (Brown 2002; Foltz and Yanosek 2005).

Instream activities will be (1) the placement of habitat structures – large diameter logs and constructed woven log jams – in the stream channel and (2) the crossing of the creek by equipment. The first pulse of turbidity and mobilization of fine sediments will occur during implementation; however, extent is expected to be localized and minor, with turbidity likely to be undetectable greater than 300 feet downstream of the site or equipment crossings. Fine sediment is also only expected to be displaced a short distance. Furthermore, sites will be completed one at a time, not simultaneously, which will decrease the intensity of the impact. A second pulse of turbidity and the mobilization of fine sediments is most likely to occur following completion of the Project, especially following storm events during the first winter. Therefore, it is assumed that there will be a temporary increase in turbidity within Knownothing Creek, Methodist Creek, and adjacent SF Salmon River following Project implementation, as well as a short-term increase in sand/silt mobilization. The potential for and magnitude of long-term impacts will be reduced by working during low-flow conditions, minimizing vegetative disturbance, and placing erosion controls prior to and during construction, including permanent soil stabilization immediately following construction.

Neither substrate/sediment nor turbidity Indicators will be sufficiently elevated during or post-Implementation to negatively affect fish or fish habitat, including food sources. Importantly, however, instream habitat structures will increase channel complexity and reduce stream velocity, which will result in the long-term benefit of better sorted gravels. In particular, the increase in pool and slow water habitat will result in accumulated spawning gravels as they collect in pool tail-outs and gradient riffles. Any changes will be local in nature, most likely restricted to the vicinity of the proposed structures. As the complexity of the stream increases, sediment will deposit intermittently throughout the creeks, rather than being transported continuously downstream. It is therefore expected that Project will have a long-term insignificant benefit on the substrate/sediment Indicator.

Due to the volume of the **SF Salmon River** compared to Knownothing and Methodist Creeks, the visual observation of turbidity when present in the mainstem is unlikely to be large in linear extent. The elevation of turbidity during storm events will be short-term, returning to baseline by the first year post-construction, if not sooner. Similarly, while there may be an insignificant to unmeasurable exportation of fine sediment, it will not alter the current substrate composition of SF Salmon River, nor have an effect on fish habitat parameters such as pool quality or width/depth ratio. The occurrence of fine sediment mobilization will decrease as riparian vegetation regrows along the Project creeks.

Chemical Contamination and Nutrients

There is a slight risk for chemicals to enter either **Knownothing** or **Methodist Creek** during implementation. Heavy equipment will be crossing creeks; and while most construction activity will be completed with equipment located upon the bank, portions of the machines (i.e., buckets and arms) will at times need to be in water or hovering over the stream.

In order to minimize the potential for chemical contamination during equipment crossings, highlighted best management practices/project design features include:

- Mechanized equipment will be inspected for oil, grease, fuel, and other leakage prior to crossing the channel. If necessary, it will be cleaned in a designated area with suitable absorbent material. Absorbent material will be disposed of in an appropriate manner.
- During the initial crossing operation at a given site, absorbent booms will be placed downriver to capture any petroleum leaks. Booms will be removed from the river following the crossing, and properly cleaned or disposed, if contaminant leak is evident. After the initial crossing at a given site, if it is demonstrated that future crossings at the same site will pose a low risk, the boom may not be required.

See the South Fork Tributary Enhancement Project EA for a full list of Best Management Practices and Project Design Features. Refueling will occur away from waterways and is not expected to have any impact to fish or fish habitat.

If a spill or leak occurs, it will be reported and cleaned-up in accordance with applicable State and Federal laws, rules, and regulations. The environmental impact of an incident is expected to be insignificant because the volume of water in the creeks is much greater than any plausible amount of leaked fluid. Vegetable oil or other biodegradable hydraulic oil will be used wherever possible in order to lessen the environmental impact of a leak. The risk for contamination will only be present when equipment is on site and working in/near the water. No biologically meaningful response or impact to aquatic habitat is expected should a spill or leak occur.

Large Woody Debris

The Project will impart a favorable effect to large woody debris in **Knownothing** and **Methodist Creeks** during Project implementation. In the short- and long-term following Project completion, large wood within the Project area, and the processes which rely upon the debris, will be benefited.

Downed wood of all sizes is a very important component of stream systems. It provides cover for fish and other animals, adds nutrients to the system as it decays, and provides a food substrate for the aquatic invertebrates at the base of the food chain. For smaller, steeper forested headwater creeks, wood is also a critical element in formation and enhancement of pool habitat (Naiman et al. 2002; Montgomery et al. 1995); and even the smallest wood pieces (e.g., trunk segments and limbs) display a function in sediment storage and step-pool enhancement for headwater systems (Jackson and Sturm 2002; Naiman et al. 2002). While all wood is important for the aquatic environment, the largest pieces of wood, called key wood, often serve as the “key” pieces of a debris jam, the point around which other, smaller debris catch up against. What comprises key wood is highly variable and is often dependent on a given stream, with elements such as length of wood versus bankfull width, presence or absence of a rootwad, and diameter of debris important considerations.

Live trees will be removed for equipment access/operation as a consequence of the Project. In total, 20 trees will be cut – 15 white alder (riparian); 3 oak trees and 2 Douglas-fir (upland). All trees will be less than 12 inches DBH. By removing trees adjacent to Knownothing and Methodist Creeks, a detrimental result is that the Project also removes the potential of those trees to eventually recruit to the system as large woody debris. However, all trees removed during project activities will be retained on-site for use in habitat structures and will therefore not be lost from the pool of potential recruits.

The installation of large diameter wood instream structures will enhance local salmonid habitat, as described above. Most wood will be acquired from off-site sources via purchases and/or private donations. Some smaller boles will be salvaged from trees removed during site preparation activities. While the amount of wood to be input to Knownothing and Methodist Creeks will be insufficient to affect the functional level of the Large Woody Debris Indicator, it will nonetheless represent an increase from the current condition. The structures are expected to remain in place for years to decades, dependent upon subsequent water-year discharge; and even if individual pieces are mobilized, it is unlikely they will move very far except in the case of historic flood conditions. These wood structures will serve as locales for locally recruited instream wood of all sizes to catch upon, enhancing the jams. While the structures are not a replacement for naturally produced large wood, they will serve as an interim solution as the riparian continues its very long-term recovery from flood scour and human impacts. The development of a riparian capable of supplying large wood (conifers preferred due to size and resistance to decay) is a process which may require decades to over a century (conifers), and is dependent upon occurrence of detrimental events such as large flood.

The Project will have no effect on large wood loading in the **SF Salmon River** because no structures will be installed.

Pool Frequency and Quality

Installation of instream habitat structures will benefit **Knownothing** and **Methodist Creeks** in regards to the pool frequency and quality Indicator. The structures will not only form pools, but will also encourage scour, increasing pool depth. The increase in pool and slower water habitat will result in accumulated spawning gravels as they collect in pool tail-outs and low gradient riffles, and is expected to locally increase the availability of suitable spawning habitat. While this Indicator will be benefitted, it will not be sufficient to allow an overall upgrade the functional level for the two creeks – the number of sites and the area expected to be affected is small compared to the length of stream within the Project area.

There will be no effect to the **SF Salmon River** concerning the pool Indicator because no instream construction is planned and there will be insufficient sediment input during or after implementation in Knownothing and Methodist Creeks to affect mainstem channel habitat attributes.

Refugia

The Project will benefit the refugia Indicator for **Knownothing** and **Methodist Creeks** by positively affecting the following key fish habitat indicators (see individual discussions for specifics): temperature, sediment/substrate, large woody debris, pool frequency and quality, and Riparian Reserves. Some benefits will be observable immediately following Project completion, while other responses will require short-term (months) or long-term (years) to fully transpire. Restoration will not be entire, in that Knownothing and Methodist Creeks as a whole will continue to be impacted by past and current stressors, but the Project will create an increased degree of functionality in regards to fish spawning and rearing habitat.

There will be no effect to the **SF Salmon River** concerning refugia because the individual subcomponents which comprise the Indicator will not be significantly affected by Project actions; where there may be an insignificant and/or immeasurable effect, it has been determined that any impact will be short in duration and neutral in the long-term.

Width/Depth Ratio

Project activities will cause sediment movement in **Knownothing** and **Methodist Creeks**, both directly because of construction and indirectly due to post-project modification of the stream by the structures (i.e., gravel retention, redirection of stream flow, expected creation of new pool features). Localized adjustments in the width/depth ratio may occur, similar to the range of natural variability which occurs on an annual basis during higher discharge events, as the creeks respond on the site-level to the new wood structures. However, there is no expectation of any change to the width/depth ratio of the streams on the larger reach scale because the number of sites and the area expected to be affected is small compared to the length of stream within the Project area.

There will be no effect to the **SF Salmon River** concerning the width/depth ratio Indicator because there will be no instream construction, bank modification will not occur, and there will be insufficient sediment input during or after construction to affect channel configuration.

Streambank Condition

The Project is expected to impact the streambanks of **Knownothing** and **Methodist Creeks** through removal of vegetation and installation of instream habitat structures. In addition to the physical disturbance caused by the installation process, the structures may affect the nearby streambank due to changes in how stream flow is directed.

In the short-term (during and immediately after construction), streambanks at and near the installation sites may be more prone to erosion. However, stabilization will occur as vegetation re-establishes in the months and years post-implementation. In the long-term, bank stability will likely be similar to the current condition with site specifics dependent on local adjustments to the presence of the structures.

There will be no effect to the **SF Salmon River** concerning the streambank condition Indicator because no bank construction activities are planned.

Disturbance History and Regime

Ground disturbance within the Project area is limited to use of temporary access routes and installation of habitat structures on the streambanks and in the stream channel.

Disturbance indices will not increase as a result of Project implementation (see Water Quality Report). The amount of disturbance planned is below the limit of resolution by the CWE models. Therefore, there will be no change in the existing risk represented by the respective CWE models at either the 5th- or 7th-field watershed level. All drainages will remain below the "1" threshold of concern (**Table 3**). Further, the Project will not undercut sensitive landforms and is not likely to increase hillslope instability (see Geology and Soil Resources Report).

As discussed in the "Affected Environment" section, there are many human-mediated historic and continuing impacts to the Project drainages which are beyond the scope of the models and therefore not captured. However, by implementing the Project, a degree of habitat complexity will be restored to Knownothing and Methodist Creeks. The Project will therefore address some of the legacy effects associated with human impact to the drainage (e.g., broad-scale simplification of channel complexity).

Riparian Reserves

The Project will benefit the Riparian Reserves Indicator for **Knownothing** and **Methodist Creeks**. While there is potential for insignificant, localized short-term negative impacts to temperature during and/or immediately after implementation due to site preparation, recovery of shade following vegetation re-establishment is anticipated. In the long-term, the Project is expected to positively affect large woody debris presence/processes and instream temperature (see "Temperature" and "Large Woody Debris discussions). The overall benefit to Riparian Reserves of Knownothing and Methodist Creeks is insignificant when considered at the landscape level due to the confounding influence of past natural and anthropogenic events. However, the purpose of the Project is not to fully restore the creeks, but rather to create an increased degree of functionality in regards to fish habitat and channel complexity. The improvement of local Riparian Reserves character is a step towards long-term recovery of habitat for all aquatic species.

There will be no effect to the **SF Salmon River** concerning the character of the Riparian Reserves Indicator because the structure installation process, including access to individual sites, occurs in association with Knownothing and Methodist Creeks, not the mainstem.

--Lamprey--

For lamprey, indirect effects to habitat are anticipated to be similar to those listed for salmonids.

Additional focus herein is upon changes in substrate composition and the potential effect to ammocoetes (larvae). Because the larvae of both lamprey species require patches of soft sand or mud in which to burrow, actions that measurably increase or decrease these materials have the potential to affect local distribution and abundance of ammocoetes. However, such is unlikely to occur as a result of the Project. As analyzed for salmonids, alteration to substrate composition expected to favor salmonid spawning due to localized deposition of gravel. While the creation of pools and slower water habitats may also foster the settling of additional finer material, overall percentage of the sands/silts required for lamprey rearing within the stream matrix for the Knownothing and Methodist Creek drainages is low (USFS 2016). Therefore, material suitable for ammocoete rearing will continue to be available at its current levels.

The increase in spawning gravel suitable for salmonids has the potential to benefit lamprey as well due to the use of similar sized material to construct their redds. Because it is unknown how far lamprey will stray from ammocoete rearing areas (which attract adults) to spawn, it is also unknown which wood installation sites may have the greatest benefit to increase lamprey spawning opportunities.

Effects to substrate composition will be undetectable in the SF Salmon River and, therefore, material suitable for ammocoete rearing and adult spawning in the mainstem will continue to be available at its current levels.

More important than the effect of individual project components to lamprey is the effect of the Project to stream habitat as a whole. Maintenance of lamprey habitat and abundance best occurs in a heterogeneous system, one which encompasses complex instream features at multiple spatial scales (Torgensen and Close 2004). The Project will maintain a complex habitat for salmonids; and in doing so, will also benefit lamprey at all life stages.

--Killer Whale (Orca)--

Killer whale (Orca) are marine mammals and the largest members of the dolphin family. The southern resident killer whale (SWKW) population is recognized as the J, K, and L pods, normally found in the inland waterways of Washington state and the transboundary waters between the United States and Canada. Recent satellite tagging has shown that some members of the southern population may be found as far south as central California during the winter months. Southern resident Orca are fish-eaters. Therefore, potential prey fish of interest would be anadromous salmonid species such as Coho salmon, Chinook salmon, and steelhead. Activities which measurably affect availability of these species as food could lead to an impact to Orca.

This Aquatic Resource Report concludes effects to anadromous fish habitat to be beneficial. A summary of potential Project effects upon fish is provided at the end of this document. For killer whale, the determination is “No Effect." The Project has very low potential to result in lethal take of anadromous salmonids during implementation. The Project is expected to increase local habitat for anadromous fish, although the number of fish to be benefitted is likely too low to impart a discernible increase to prey availability for Orca. Overall, without a measurable change in food-fish species numbers, there can be no effect to Orca.

Table 5. Summary of the effects of each Indicator on salmonid fish of Alternative 2 of the South Fork Tributary Enhancement Project for project element/indicator combinations. Indicator applies to both anadromous and resident fish, unless specified otherwise.

Indicators	Structure Installation Activities	Comments
Temperature	-/+	Potential short-term impact to Knownothing and Methodist Creeks due to change in stream shade; long-term benefit due to increase in the amount and residence time of hyporheic flow.
Turbidity	-/0	Turbidity may be present during and for a short time following installation of instream structures; long-term, turbidity will return to baseline (see Water Quality Report).
Chemical Contamination/ Nutrients	-/0	No chemical treatments, fertilizers, or nutrient treatments will be used; BMP/PDFs for fuel use, channel crossings, and use of equipment in/near the stream.
Physical Barriers	0	Knownothing Creek includes a human-built barrier which may affect fish distribution. However, removal or modification of this barrier is beyond the scope of the Project.
Sediment/Substrate	-/+	Fine sediments may be mobilized during and for a short time after implementation; erosion will return to baseline or decrease long-term as streambanks stabilize (see Water Quality Report; Geology/Soil Resources Report). Increased channel complexity and reduced water velocity will result in a localized better sorting of gravels and improved spawning and rearing habitat.
Large Woody Debris	+/+	Live trees removed for equipment access/operation will be retained for use in habitat structures. In the short- and long-term after implementation, LWD presence in the creeks will be benefited.
Pool Frequency and Quality	0/+	Instream habitat structures will create new pool habitat and increase quality compared to existing conditions.
Off-Channel Habitat	0	Not present in Project area
Refugia	+/+	Instream habitat structures will provide for increased fish habitat functionality in both the short- and long-term.
Width/Depth Ratio	0/0	Although there may be localized width/depth ratio adjustments due to sediment movement, no change in ratio is expected on the reach level.
Streambank Condition	-/0	Short-term instability during and after structure installation. In the long-term, bank stability is expected to be similar to the existing condition.
Floodplain Connectivity	0	No change to peak flows is expected; floodplains will continue to inundate at their current rate.
Change in Peak/Base Flows	0	There will be no change in peak/base flows (see Water Quality Report).
Increase in Drainage Network	0	The existing hydrologic connectivity between the road system and the stream system will not be affected. There will be no building of new roads, ditches, or other impervious surfaces that may transport water.
Road Density and Location	0	No new system roads will be constructed.
Disturbance History and Regime	0/+	While there is no change in disturbance and erosion indices (see Water Quality Report), the Project does address some legacy anthropogenic impacts.
Riparian Reserves	-/+	Project activities will impart minor, short-term effects. Long-term benefits are expected as riparian area recovers and channel complexity increases.

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

Cumulative Effects

Within the Project area, there are no foreseeable non-Federal (i.e., private or State) actions planned or undergoing implementation at the time of this document.

Future foreseeable Federal actions include (1) Discovery Day Mine, (2) Hotelling Gulch Fish Passage and Channel Restoration Project, (3) Knownothing Fuels Reduction Project, and (4) active mining (placer) claims.

(1) The Discovery Day Mine is a hardrock mine in the Knownothing Creek drainage. The proposal is to reauthorize the Plan of Operations for future activity. This action will include updating various aspects of operations, including permitted activities, haul timing, erosion control requirements, and so forth. The project is currently in the initial stages of planning; and it may be one or two (or more) years before environmental and consultation documents are finalized.

No cumulative impact is expected. While there is no physical overlap of the Discovery Day Mine and the South Fork Tributary projects, these Projects both share the larger Knownothing Creek watershed and are close in space. Dependent upon exact details of the mine operations plan, there could be impacts associated with sediment and turbidity, in particular crossing vehicles too large for the adjacent bridge through a ford located upon WF Knownothing Creek about 1000 feet above the uppermost South Fork Tributary Knownothing Creek structure. Because both projects have the potential to affect sediment and turbidity, there is the potential for a cumulative response in Knownothing Creek <u>if</u> they were to be implemented simultaneously. However, there will be no temporal overlap: the South Fork Tributary project is expected to be completed in 2017; and while there is no estimated date for Discovery Day Mine operations to begin, the permitting process is expected to require several years. Because there is no temporal overlap, there will be no potential for additive disturbance.

(2) The <u>Hotelling Gulch Fish Passage and Channel Restoration Project</u> is proposed to increase access to low gradient fish habitat in Hotelling Gulch, and improve natural stream function and the transport of watershed products to the Salmon River. Channel modification and upgrading a current culvert crossing will be implemented to achieve project objectives. The project is currently in the latter stage of planning, with the Environmental Analysis document being finalized in preparation for a decision.

No cumulative impact is expected. While there is no physical overlap of the Hotelling Gulch and the South Fork Tributary projects, these Projects both share the 5th-field watershed and are close in space. Additionally, both propose in-channel activities, which could impart a cumulative response to the SF Salmon River in regards to sediment and turbidity impacts <u>if</u> they were to be completed simultaneously. However, there will be no temporal overlap: the South Fork Tributary project is expected to be completed in 2017, and the earliest estimated time for Hotelling Gulch implementation is 2019. Because there is no temporal overlap, there will be no potential for additive disturbance.

(3) The <u>Knownothing Fuels Reduction Project</u> will continue implementation of fuels reduction activities on approximately 11 acres. General location is east of the mouth of Knownothing Creek, upslope of County Road 1C02. Actions include manual removal and piling of ladder fuels, brush, and hazardous snags. Handpiles are burnt to dispose of the organic matter. Implementation started in 2013 and occurs based upon staff and burn window availability.

No cumulative impact is expected. Although the 7th-field watershed is shared, there is no physical overlap of Knownothing and the South Fork Tributary projects. As there is no spatial overlap of actions, there will be no potential for additive disturbance. Additionally, it was determined that the Knownothing Project would have "No Effect" to analysis species (USFS 2011). Finally, because the Knownothing Project has been analyzed and is being actively implemented, it is considered a current/existing action already included in pre-Project CWE modeling.

(4) Another foreseeable Federal action within the Project area is continued implementation of <u>18 active mining (placer) claims</u>. Mining claims are considered to be a Federal, not private, action when located upon Forest Service administered property because oversight for compliance with local, State, and Federal regulations concerning mining is the responsibility of the Forest Service. (Note: most enforcement actions are the duty of the State.) Locations of claims include Knownothing Creek (8), Methodist Creek (5), and SF Salmon River mainstem (5). As claimants have not filed Plans of Operation, activities are expected to be manual and limited in extent: panning, sluicing, high-banking, and similar. Dredging is currently not allowed due to a moratorium by the State of California.

There is the potential for cumulative impact. Claims appear to have a physical overlap with the South Fork Tributary project along Knownothing Creek. Because of the imprecise location information in the database it is difficult to distinguish the exact claim location in order to determine where it is in respect to a structure site. Cumulative impact occurs when the effect of one project overlaps with or compounds the effects of another. For example, the local influence of a log structure to settle gravel and other fines could influence a claimant to shift work to focus on the new material. However, when the larger scale is considered, any cumulative impact will be very minor – all claims are considered to be a current/existing action (i.e., there will be no new claims are a result of structure installation); and due to the small-scale nature of current activities, there is no expectation that claimants will increase their existing use footprint or intensity, even if there is an adjustment in focus.

Finally, while past events within the Project area – e.g., mining, timber harvest, road building, grazing, flood, fire – contribute to the existing condition, this Project will not produce an additive effect.

In summary, there is the potential for additive adverse impacts to aquatics from current and reasonably future foreseeable projects within the vicinity of the South Fork Tributary Enhancement Project. However the potential is minimal and focused exclusively within Knownothing Creek where log structures may overlap with existing placer claims, and will not result in cumulative adverse impacts to aquatics resources.

Summary of Effects

Direct effects to Coho salmon, Forest Service Sensitive species and management indicator species and their habitat may occur as a result of the installation of habitat structures in the stream channel of Knownothing and Methodist

Creeks. Dewatering the work sites would result in a greater disturbance to the stream and fisheries than will be caused by constructing the structures. Therefore, the sites will not be dewatered and fish relocation will not occur. Fish temporarily avoiding equipment crossing locations and activity sites are not likely to experience reduced feeding success, nor result in a significantly higher probability of exposure to predators.

Potential indirect impacts to aquatic resources will occur as a result of equipment access and operation as well as construction of instream habitat structures. However, any detrimental effects will be localized, insignificant, and will impart no consequential impact to fish or fish habitat, including Coho and Coho Critical Habitat. The CWE models will not be affected by Project actions. Resource protection measures including Project Design Features and Best Management Practices will provide decrease the probability and magnitude of potential impacts to aquatic resources. There will be multiple benefits to fish and fish habitat upon completion of the project; some improvements will be immediate, while others may require months or years to be observed. Most importantly, the Project will provide for a wide range of habitat heterogeneity for juvenile and adult salmonids and will increase stream flow residence time, thereby improving surface water and groundwater interaction.

There will be no indirect impacts to Killer Whale (Orca)/SRKW. The Project has very low potential to result in lethal take of anadromous salmonids during implementation; long-term, all anadromous species are expected to be benefited by the improvement in habitat condition within Knownothing and Methodist Creeks. However, these actions will not result in a measurable increase or decrease in availability of food-fish species within the ocean; and without a discernible change, there can be no effect to Orca.

Therefore, the Aquatic Biologist has reached the following determination:

Table 6. Summary of determinations for Alternative 2 (Proposed Alternative) for the South Fork Tributary Habitat Enhancement Project.

Species	Special Status	[1]Determination
	Fishes	
Coho Salmon (and CH)	Federally Threatened	NLAA
Chinook Salmon (Spring/Fall runs) (Upper Klamath-Trinity Rivers)	FSS	MANL
Steelhead Trout (Klamath Mountains Province)	FSS, MIS	MANL
Rainbow Trout (resident)	MIS	MANL
Pacific Lamprey	FSS	MANL
Klamath River Lamprey	FSS	MANL
	Mammal	
Killer Whale (Orca)	Federally Endangered	NE
	Other Habitat	
Essential Fish Habitat (Coho/Chinook)	EFH	NLAA

[1]Federally Listed Species
NE - Will not affect the species or its Critical Habitat
NLAA - May affect, not likely to adversely affect the species or its Critical Habitat
LAA - May affect, likely to adversely affect the species or its Critical Habitat

Forest Sensitive Species (FSS) / Management Indicator Species (MIS)
NE - No effect to the species (FSS and MIS)
MANL - May affect individuals, but is not likely to lead to a trend towards listing (FSS); and/or
May affect individuals, but is not likely to lead to a decreasing population trend (MIS)
MALT - May affect individuals, and is likely to result in a trend towards listing (FSS); and/or
May affect individuals, and is likely to lead to a decreasing population trend (MIS)

Installation of instream habitat structures will benefit several Indicators, in particular Large Woody Debris, Substrate Condition, Pool Frequency and Quality. However, it will primarily be localized in nature and not be of sufficient degree to permit an upgrade from current baseline functionality when considered at the larger reach or landscape level.

Table 7. Indicator summary for South Fork Tributary Habitat Enhancement Project alternatives.

Indicator	Alternative 1 (no action)	Alternative 2 (proposed)
Temperature	0	-/+
Turbidity	0	-/0
Substrate/Sediment	0	-/+
Chemical Contamination/Nutrients	0	-/0
Large Woody Debris	0	+/+
Pool Frequency/Quality	0	0/+
Refugia	0	+/+
Width/Depth Ratio	0	0/0
Streambank Condition	0	-/0
Disturbance History/Regime	0	0/+
Riparian Reserves	0	-/+

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

Compliance with law, regulation, policy, and the Forest Plan

All Alternatives will meet Forest Plan Standards and Guides, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Northwest Forest Plan, and all other relevant regulations, laws, and policies. Section 7 consultation will be completed with the National Marine Fisheries Service for Alternative 2 (Proposed Action) by coverage under the Restoration Center’s programmatic document (NOAA 2012).

The Project is consistent with the goals and objectives, and would implement specific recovery actions, in the SONCC Coho salmon recovery plan (NOAA 2014). That document identifies large woody debris as a desirable action for increasing channel complexity to benefit Coho habitat (pg. 35-21). The Project would increase Coho habitat by constructing large woody debris instream habitat structures in Knownothing and Methodist Creeks.

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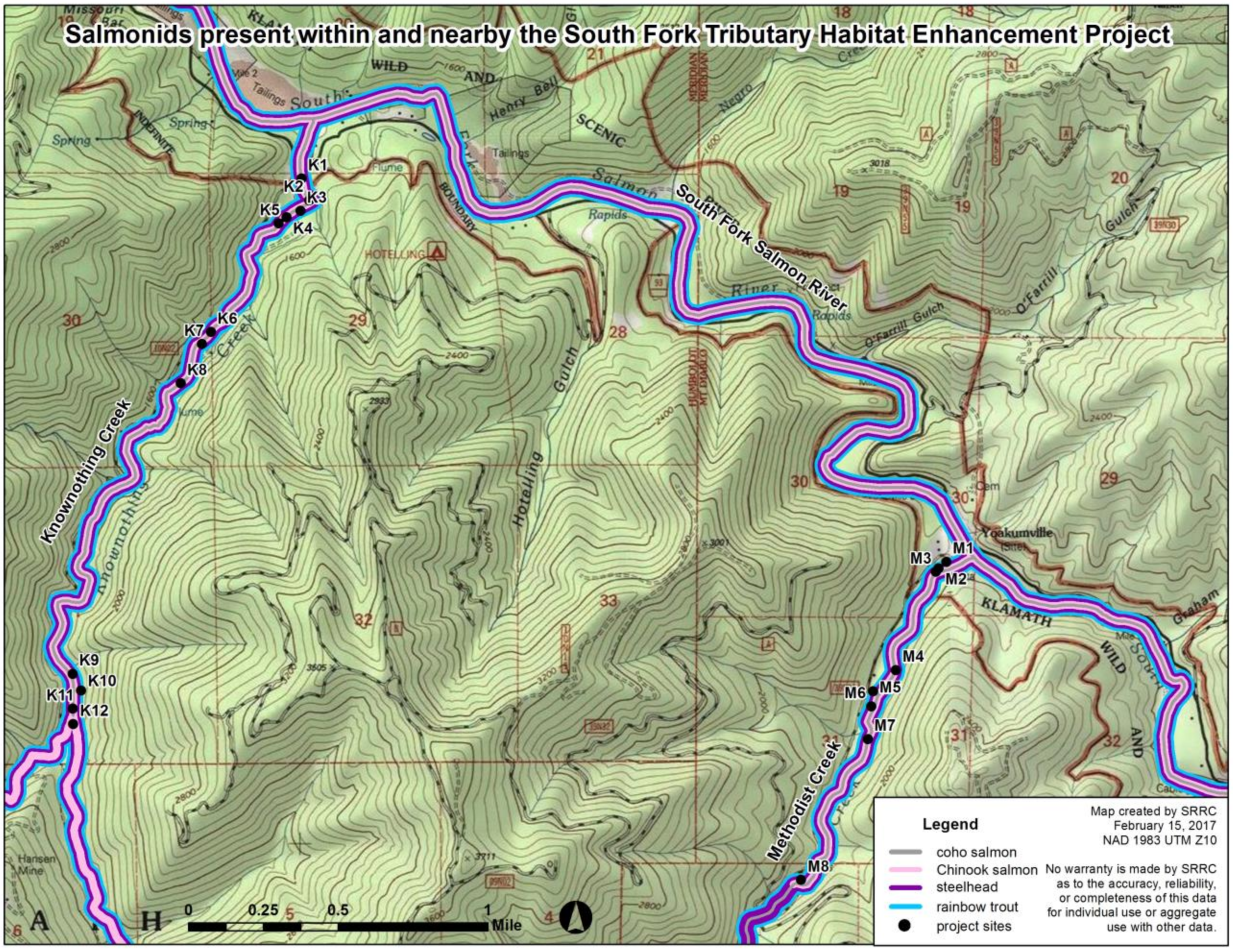
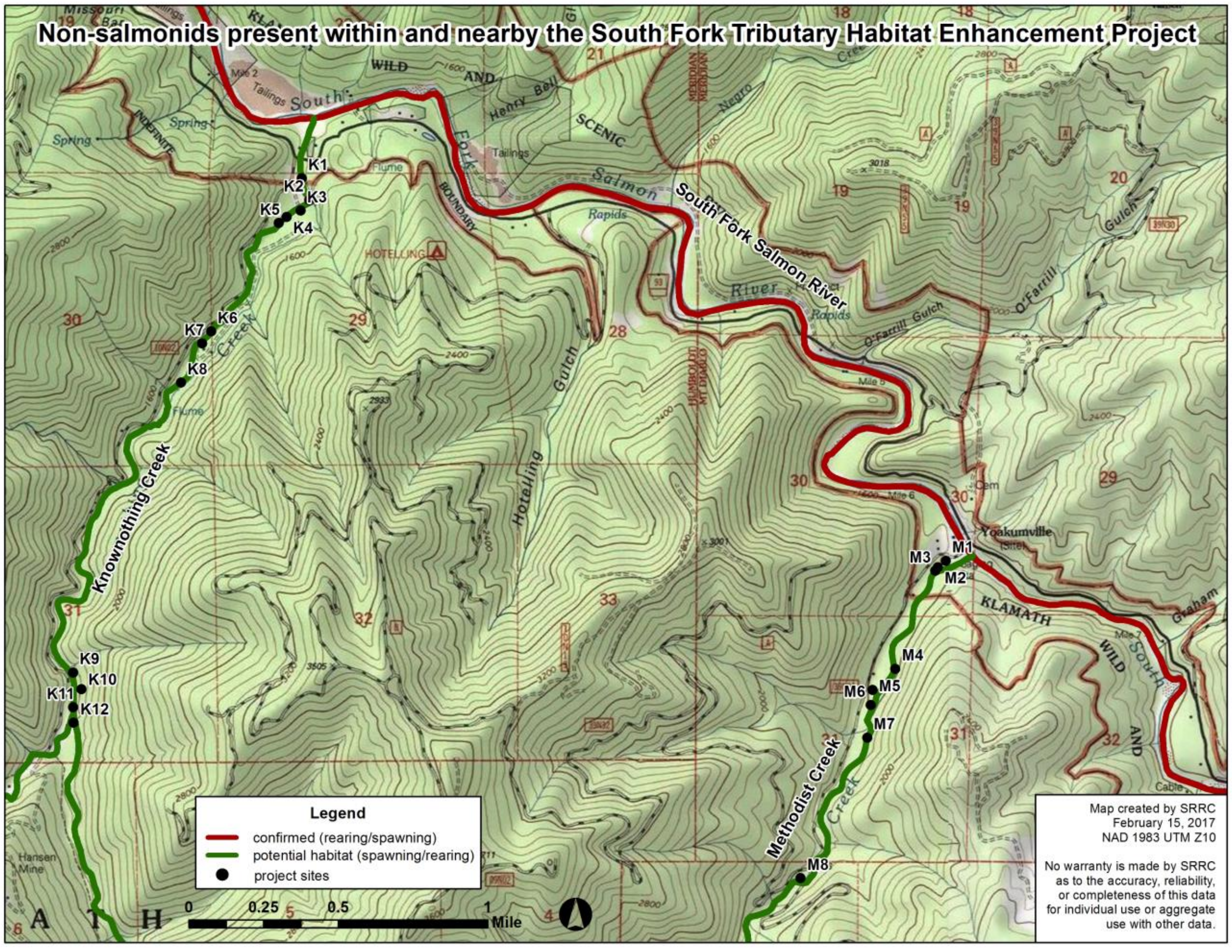
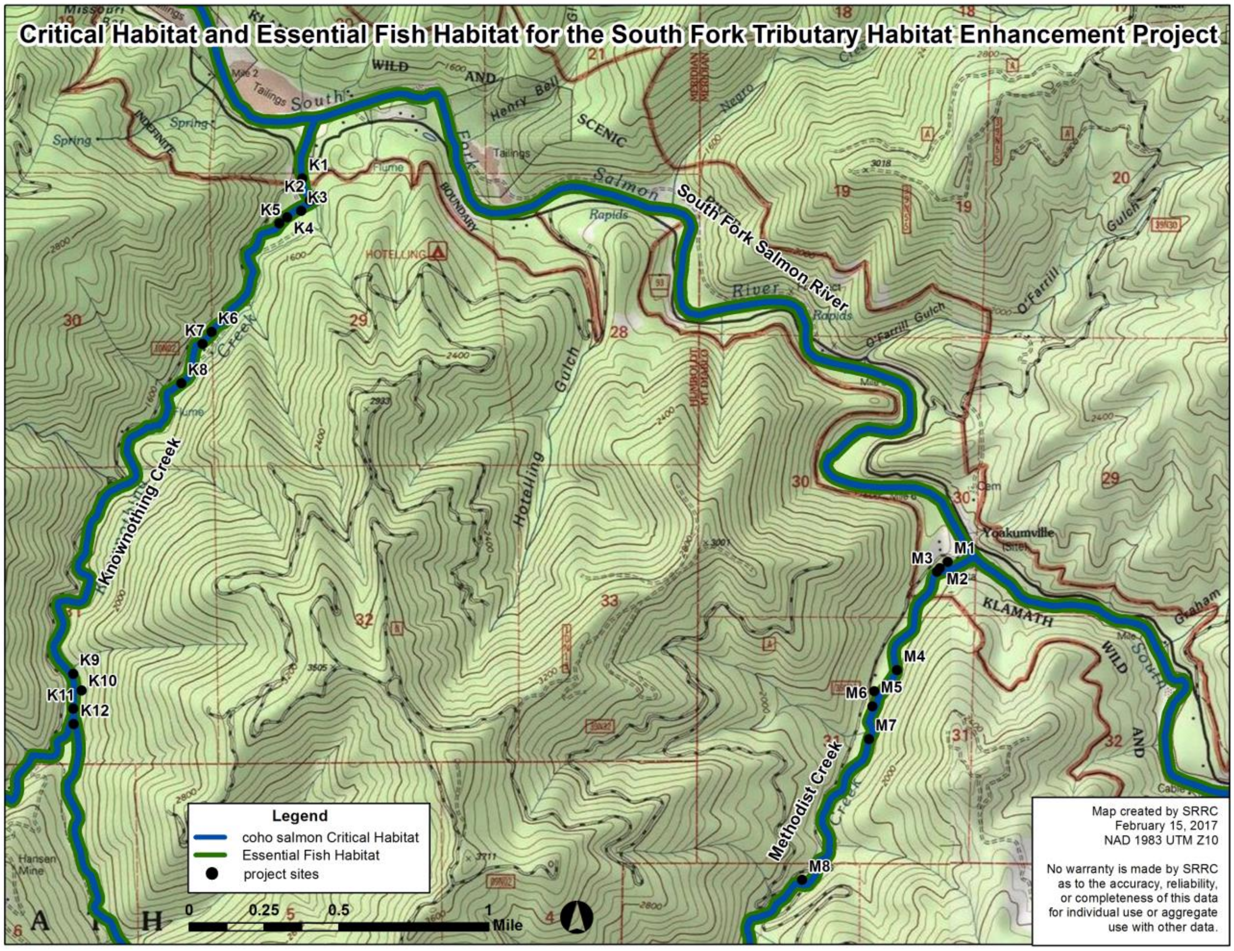
Maps



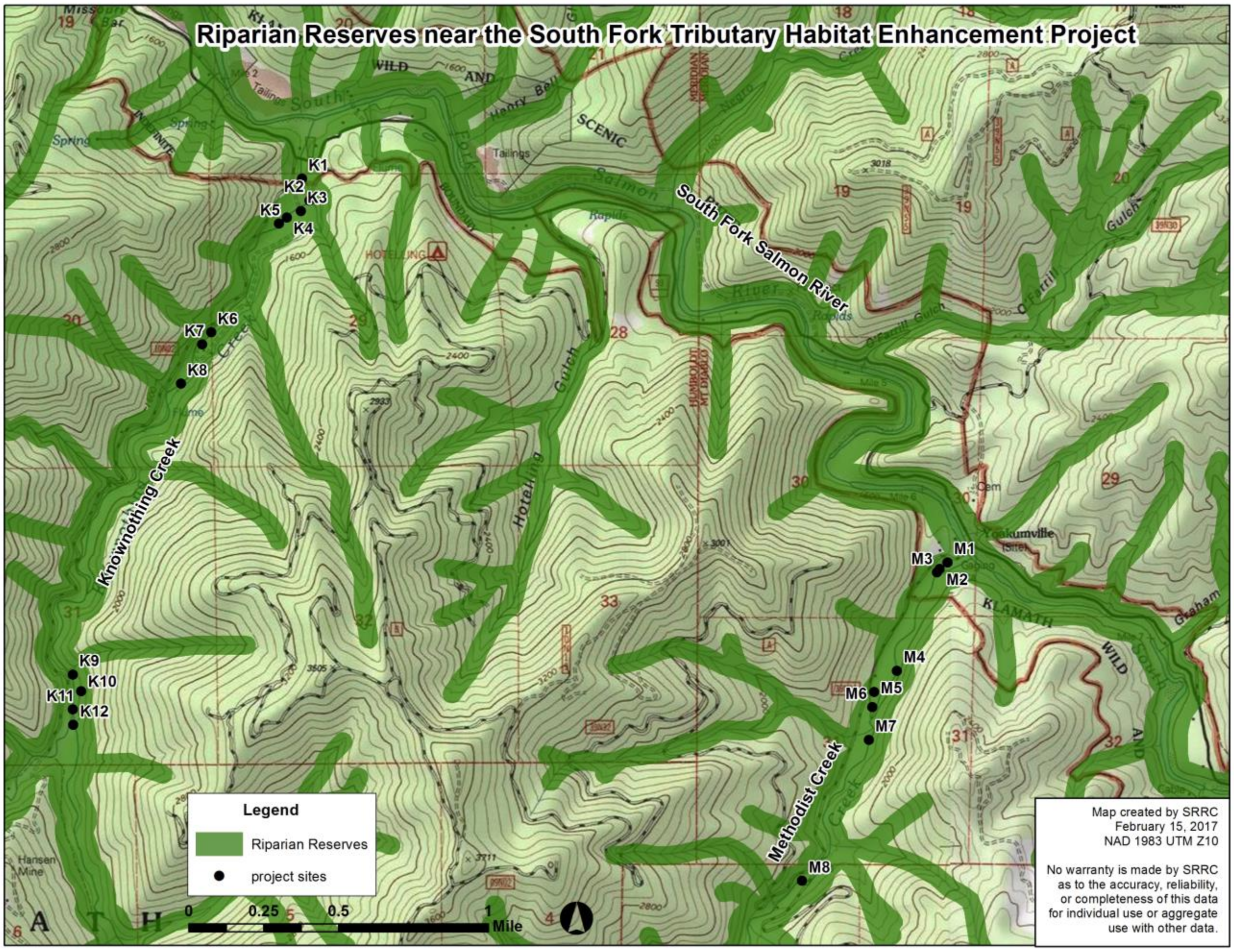
Map 1. Aquatic resources (salmonids) present within and nearby the South Fork Tributary Habitat Enhancement Project.



Map 2. Aquatic resources (non-salmonid) present within and nearby the South Fork Tributary Habitat Enhancement Project.



Map 3. Coho Critical Habitat and Essential Fish Habitat for the South Fork Tributary Habitat Enhancement Project.



Map 4. Project sites with hydrologic Riparian Reserves.

Appendix A: Life history and biological requirements of Pacific salmonids and lamprey

Coho Salmon

General life history information and biological requirements of Southern Oregon/Northern California Coastal (SONCC) Coho salmon have been described in various documents (Hassler 1987; Sandercock 1991; Weitkamp, *et al*. 1995) as well as NOAA-Fisheries' final rule listing SONCC Coho salmon (May 6, 1997; 62 FR 24588) and the subsequent Recovery Plan (NOAA 2014).

Coho salmon enter the mainstem of the Klamath River for spawning typically in their third year, primarily between September and December, with a peak in October (NFMS 2007). Over most of this interval, mainstem flows below Iron Gate Dam often are high (ca. 2500-3000 cfs: NMFS 2001). Thus, standard methods for observing and counting spawning fish are not easily applied, and the size of the spawning population is unknown. Approximations put the entire ESU at about 10,000 spawning Coho salmon of non-hatchery origin per year (Weitkamp, *et al*. 1995), of which only a small portion is associated with the Klamath Basin, where several important tributary runs have been reduced to a handful of individuals (NMFS 2001, 2007). Although a minor amount of spawning and growth may occur in the mainstem, the mainstem serves adults primarily as a migration route (NFMS 2007).

Spawning occurs from November to January (Hassler 1987) in the tributaries to the Klamath River, but occasionally as late as February or March (Weitkamp, *et al*. 1995). Coho salmon eggs incubate for 35-50 days between November and March. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Fry start emerging from the gravel two to three weeks after hatching and move into shallow areas with vegetative or other cover. As fry grow larger, they disperse up or downstream. In summer, Coho salmon fry prefer pools or other slower velocity areas such as alcoves, with woody debris or overhanging vegetation. Juvenile Coho salmon over-winter in slow water habitat with cover as well. Juveniles may rear in fresh water for up to 15 months then migrate to the ocean as smolts from March to June (Weitkamp, *et al.* 1995). Coho salmon adults typically spend two years in the ocean before returning to their natal streams to spawn as three-year olds.

Available historical and most recent published Coho salmon abundance information are summarized in the NOAA-Fisheries coast-wide status review (Weitkamp, *et al*. 1995). The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as native fish occurring in tributaries having little history of supplementation with non-native fish. However, limited information exists regarding Coho salmon abundance in the Klamath River basin. What information exists [NOAA 2014; CDFW unpub. data; U.S. Fish and Wildlife Service (USFWS) unpub. data] suggests adult populations are small to nonexistent in most years. The decline of SONCC Coho salmon across the ESU is not the result of one single factor, but rather a number of natural and anthropogenic factors that include dam construction, instream flow alterations; land use activities coupled with large flood events, fish harvest and hatchery effects.

Knownothing & Methodist Creeks – Coho Surveys

Coho are present in Knownothing and Methodist Creeks. A comprehensive review of datasets originating from multiple agencies/entities was conducted by CDFW; presence of Coho salmon was substantiated (Garwood 2012).

Knownothing Creek is considered to be suitable Coho habitat from the mouth to its confluence with the East and West forks (~2.5 miles). Snorkeling associated with Forest Service habitat surveys noted presence of Coho juveniles in 1988, 1989, 1992, and 1998. Thermal refugia surveys occurred in 2005 and 20014 by SRRC (SRRC 2005, 2014). Coho were not seen in 2005; and in the 2014 visit, juvenile Coho were observed both in the thermal refugia, as well as in the stream about 3000 feet (~0.6 mile) upstream of the mouth. Coho redds were also identified during spawning surveys in 2006 and 2009 (SRRC 2010, 2007).

Methodist Creek is considered to be suitable Coho habitat from the mouth to its confluence with Sign Creek (~2.4 miles). Snorkeling associated with Forest Service habitat surveys noted the presence of Coho juveniles in 1988, 1989, and 1992 (unpub. data). Thermal refugia surveys by SRRC observed Coho juveniles at the mouth and within the stream in both 2005 and 2014; and fish in 2014 were observed to 80 feet upstream of the mouth. Spawning surveys in 2004 recorded several adult Coho (SRRC 2007).

*CalFish query performed on 2/11/2017

- No live/dead fish nor redd counts available
- Coho distribution maps do include Methodist Creek and Knownothing Creek

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Unpublished data and/or field notes from 1988, 1989, 1992, and 1998.

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SF Salmon River – Coho Surveys

Coho are present in the SF Salmon River in the general project area, with a focus on the reach between Indian Creek and Forks of Salmon (~River mile 7.6 to mile 0).

Coho spawning surveys of the SF Salmon River within the Project area are not conducted due to dangerous discharge conditions and poor water visibility present during mid-winter. Occasional adult Coho – live or carcasses – are incidentally reported in the SF Salmon River during fall Chinook spawning surveys, including the focus reach which includes Project area (USFS 2011, 2012, 2013).

Observations of rearing juveniles during summer and fall is considered the best indicator of Coho presence. Snorkeling associated with Forest Service habitat surveys observed Coho between Knownothing Creek and Methodist Creek in 1990; and SRRC crew also reported juveniles in 2002 in this stretch of river (SRRC 2007). Surveys of thermal refugia and other habitat for juvenile salmonids were conducted on the SF Salmon River in 2005 and 2014 (SRRC 2005, 2014). Coho juveniles have been observed using the thermal refugia zone of both Knownothing Creek and Methodist Creek.

Finally, a comprehensive review of datasets originating from multiple agencies/entities was conducted by CDFW, with the conclusion that Coho presence in SF Salmon River was substantiated (Garwood 2012).

*Location restricted, where possible, to general Project area (Indian Creek to Forks of Salmon)

*CalFish query performed on 6/6/2016

- See project record for expanded datasets referred in summary
- Coho distribution maps include the SF Salmon River in the Project area

Live/Dead Fish Count

- CalFish records available (1): 90357
    - Inclusive years (all datasets): 1992-1998
- Summary: Coho recorded most years (within the focus reach)

Unpublished data and/or field notes from 1990.

Garwood, J. 2012. Historic and recent occurrence of Coho salmon (*Onchorhynchus kisutch*) in California streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Fisheries Branch Administrative Report, 2012-03. California Department Fish and Wildlife, Arcata, CA. 77 p.

Salmon River Restoration Council (SRRC). 2014. Salmon River juvenile Coho survey report. Salmon River Restoration Council, Sawyers Bar, CA. 3 p + data.

Salmon River Restoration Council (SRRC). 2007. Salmon River weak stocks assessment program 2006: June 1, 2006 through September 30, 2007. Final Report. Grant #P04103330. Prepared for California Department Fish and Game by Salmon River Restoration Council, Sawyers Bar, CA. 26 p + appendices.

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

U.S. Forest Service (USFS). 2013. 2012 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 15 p + appendices.

U.S. Forest Service (USFS). 2012. 2011 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 15 p + appendices.

U.S. Forest Service (USFS). 2011. 2010 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 12 p + appendices.

Chinook Salmon

The following information was excerpted or summarized from NMFS status review of Chinook salmon (Meyers, *et al.* 1998). Chinook salmon mature between 2 and 6+ years of age (Meyers, *et al.* 1998). Fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991). Incubation temperature for eggs is 5.0 to 14.4°C, with below 13.0°C preferred for optimal development in most stocks (McCullough 1999). Emerging fry generally do not develop normally above 12.8°C (McCullough 1999). Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. Once feeding, the optimal growth range for juveniles is 10.0 to 15.6°C, with fingerlings preferring to hold at 12 to 14°C (McCullough 1999). In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water. For Chinook salmon, the recommended maximum temperature to maintain migratory response and seaward adaptation is 12.0°C; and at temperatures greater than 13.0°C, some physiological processes of smolting may be delayed, and, in extreme cases, reversed (McCullough 1999). Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Meyers, *et al*. 1998). Chinook salmon addressed in this document exhibit an ocean-type life history, and smolts out-migrate predominantly as subyearlings, generally during April through July. Chinook salmon spend between 2 and 5 years in the ocean (Healey 1991), before returning to freshwater to spawn. Some Chinook salmon return from the ocean to spawn one or more years before full-sized adults return.

The UKT ESU includes fall- and spring-run Chinook salmon in the Klamath and Trinity River Basin upstream of the confluence of the Klamath and Trinity rivers. Historically, spring-run Chinook salmon were probably the predominate run. This ESU still retains several distinct spring-run populations, albeit at much reduced abundance levels. Fish from this ESU exhibit an ocean-type life history; however genetically and physically, these fish are quite distinct from coastal and Central Valley Chinook salmon ESUs. Genetic analysis indicated that this ESU form a unique group that is quite distinctive compared to neighboring ESUs. The majority of spring- and fall-run fish emigrate to the marine environment primarily as subyearlings, but have a significant proportion of yearling smolts. Recoveries of coded wire tags indicate that both runs have a coastal distribution off the California and Oregon coasts. The 2016 fall-run Chinook salmon run into the Klamath River system, as compiled by CDFW, was estimated to be 19,948 fish (17,502 adult and 2,446 grilse). Of the 15,818 basin-wide natural spawners (i.e., not of hatchery origin), 1,058 were from the Salmon River and 1,515 from the Scott River. The Klamath River run in 2016 was projected to be below average compared to recent historical average (KRTT 2016).

Knownothing & Methodist Creeks – Chinook Surveys

Chinook are present in Knownothing and Methodist Creeks.

Knownothing Creek is considered to be suitable Chinook habitat from the mouth to its confluence with the East and West forks (~2.5 miles); and additional occupation also occurs on both the East Fork and West Fork. Snorkeling associated with habitat surveys noted presence of Chinook juveniles in 1988, 1989, and 1998. Juvenile Chinook were additionally noted in the vicinity of the mouth during thermal refugia surveys by SRRC in 2005 (SRRC 2005). Finally, an adult Chinook was seen during Forest Service substrate surveys in 1992; and as the observation month was September, such indicates the fish to have been a spring Chinook. Several adult spring Chinooks were also observed during SRRC thermal refugia surveys 2014 about 1,500 feet upstream of the mouth (SRRC 2014).

Methodist Creek is considered to be suitable Chinook habitat from the mouth to just above the Forest Service 39N34 bridge (~1.4 miles). Snorkeling associated with Forest Service habitat surveys saw no juveniles during visits in 1988, 1989, or 1992. Thermal refugia surveys by SRRC observed Chinook juveniles at the mouth and within the stream in 2005 (SRRC 2005). A thermal refugia survey in 2014 did not specify Chinook presence at the mouth, but did report juveniles about 0.9 miles upstream of the mouth (SRRC 2014).

Spawning surveys targeting Chinook have occurred intermittently on both Methodist and Knownothing Creeks since 1983, with fish and/or redds reported most years (most recent report: USFS 2016). The focus has primarily been on the fall-run, although some surveys have happened early enough (September through early-October) to have potentially captured spring-run Chinook.

*CalFish query performed on 2/11/2017

- No live/dead fish nor redd counts available

- Chinook distribution maps do not include Knownothing and Methodist Creeks

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Unpublished data and/or field notes from 1988, 1989, 1992, and 1998.

Salmon River Restoration Council (SRRC). 2014. Salmon River juvenile Coho survey report. Salmon River Restoration Council, Sawyers Bar, CA. 3 p + data.

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

U.S. Forest Service (USFS). 2016. 2015 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 23 p + appendices.

U.S. Forest Service (USFS). 2015. 2015 Spring Chinook/Summer Steelhead dive results. Klamath National Forest Service, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 1 p.

SF Salmon River – Chinook Surveys

Chinook are present in the SF Salmon River in the general project area, with a focus on the reach between Indian Creek and Forks of Salmon (~River mile 7.6 to mile 0).

Spawning surveys targeting Chinook have occurred on the SF Salmon River in the Project area since 1985, with fish and/or redds reported most years (most recent report: USFS 2016a). Focus has primarily been on the fall-run, although some surveys have happened early enough (September through early-October) to capture spring-run Chinook. Also, spring Chinook are routinely reported during the annual spring Chinook/summer steelhead dive event (late-July or early-August) since 1990 (most recent report: USFS 2016b).

Surveys of thermal refugia and other habitat for juvenile salmonids were conducted on the SF Salmon River in 2005 (SRRC 2005). Chinook juveniles have been observed using the thermal refugia zone, else be in the vicinity of the mouth a short distance upstream, of both Knownothing Creek and Methodist Creek.

*Location restricted, where possible, to general Project area (Indian Creek to Forks of Salmon)

*CalFish query performed on 6/6/2016
- See project record for expanded datasets referred in summary
- Chinook distribution maps include the SF Salmon River in the Project area

Live/Dead Fish Count
- CalFish records available (5): 91143, 91482, 91483, 91486, 91487
    - Inclusive years (all datasets): 1980, 198, 1990-2013
- Summary: Chinook recorded all years (within the focus reach)

Redd Count
- CalFish records available (2): 90075
    - Inclusive years (all datasets): 1971, 1972, 1978, 1981-1992, 1994
- Summary: Redds recorded all years
- Note: specific locations not provided; lower SF Salmon River, including focus reach, not part of the record in 1981, 1982, 1983, 1984, 1985, 1988, 1989

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

U.S. Forest Service (USFS). 2016a. 2015 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 23 p + appendices.

U.S. Forest Service (USFS). 2016b. 2016 Spring Chinook/Summer Steelhead dive results. Klamath National Forest Service, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 1 p.

Steelhead

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Moyle 2002). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (August 9, 1996, 61 FR 41542; Barnhart 1986). South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel rivers, and in Redwood Creek (Busby, *et al.* 1996).

Winter steelhead in California enter fresh water after rivers rise in response to fall/winter rains, typically from December through March, with a peak in January and February, with spawning soon after reaching the breeding grounds (Moyle 2002). In contrast, summer steelhead enter systems as flows taper off in the spring, then spawn the following winter (Moyle 2002). Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5%) tributary streams (Nickelson, *et al*. 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s, and clean substrate 0.6-10.2 cm (Nickelson, *et al*. 1992) are required for spawning. Steelhead spawn in 3.9-9.4°C water (Bell 1991). Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months (August 9, 1996, 61 FR 41542) before hatching, generally between February and June (Bell 1991). After two to three weeks, in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams. Fry occupy stream margins (Nickelson, *et al*. 1992). Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson, *et al*. 1992). Steelhead prefer water temperatures ranging from 12-15°C (Reeves *et al*. 1987). Juveniles live in freshwater from one to four years (usually two years in the California ESUs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead populations generally smolt after two years in fresh water (Busby, *et al*. 1996).

The KMP steelhead ESU occurs in coastal river basins between the Elk River in Oregon and the Klamath River in California, inclusive. The KMP steelhead ESU contains populations of both winter and summer steelhead. The Rogue and Klamath River basins are distinctive in that they are two of the few basins producing “half-pounder” steelhead. In 2001, NOAA-Fisheries reconsidered the status of KMP steelhead under the ESA (66 FR 17845, April 4, 2001) and determined that KMP steelhead do not warrant listing as threatened or endangered at this time.

In California, the largest proportions of naturally spawning hatchery fish are believed to occur in the Trinity River, where estimates from 1990s range from 20-70 percent hatchery. These estimates apply to fall-run fish. Because the hatchery program in the Trinity River basin propagates mostly fall-run fish, natural spawners in this basin that return at other times are believed to be predominantly of natural origin. Counts at Willow Creek weir provide an estimate of about 2000 natural origin fall-run spawners per year. The Willow Creek weir samples steelhead only over a period of about 3 months during the fall run and thus provides no information about other runs in the basin. CDFW biologists estimated natural escapement in the California portion of the ESU to be approximately 30,000-50,000 adults per year.

Rainbow Trout

Rainbow trout are native to Pacific slope drainages from the Kuskokwim River in Alaska to Baja California, Mexico (Moyle 2002). However, their distribution has expanded significantly, including previously fishless streams and lakes, due to introductions. Rainbow trout is a Management Indicator Species (MIS) in on the Klamath National Forest.

Rainbow trout inhabit a wide variety of habitats. However, stream dwelling rainbows tend to prefer waters with a higher percentage of riffles than pools. Optimal habitat conditions include temperatures between 15 and 18ºC, slightly alkaline water (pH 7-8), and oxygen concentrations close to saturation. Temperatures above 28ºC are known to be lethal to rainbow trout; and for large fish, lethal temperatures may be around 23-25ºC. In summer, where water temperatures begin to approach the upper range of tolerance, trout will seek cooler microhabitats (Moyle 2002).

Adult forage and dispersal patterns appear to vary with local conditions, environmental factors, and the presence of other fish species (Meehan and Bjornn 1991, Moyle 2002). Rainbow trout are typically diurnal, opportunistic feeders. They are carnivores that feed in a rover-predator style. The majority of their diet consists of aquatic insects, although they will eat crayfish, grasshoppers, winged bugs, worms, salamanders, and other fish (including other trout). They occasionally feed on benthic invertebrates when the benthic food supply is great and/or when there is increased competition for prey form the water column (Behnke 2002).

Rainbow trout usually spawn between the ages of 2 to 4 years old. Age of first spawn can vary greatly depending on size and genetics (Behnke 2002). Female fecundity ranges from 1,200-3,200 eggs per kilogram of body weight (Behnke 2002). Rainbow trout spawning behavior typically begins during the spring but can begin as early as in December and varies due to temperature and water flow conditions. Temperatures of 3-6ºC often initiate spawning behavior, although actual spawning does not usually occur until temperatures reach 6-9ºC (Behnke 2002). In lakes, this often means moving from the lake into their natal stream. If the lake is not stream-fed, rainbow trout will move into near-shore shallow waters (Moyle and Cech 2000). In rivers, rainbow trout will migrate from feeding areas into smaller, cool-water tributaries (Moyle and Cech 2000). Both rainbow and steelhead trout are iteroparous, meaning that they can spawn more than once throughout their lifetime.

Knownothing and Methodist Creeks – Steelhead/Rainbow Trout Surveys

Steelhead and rainbow trout are present in Knownothing and Methodist Creeks. Steelhead and rainbow trout juveniles are generally not differentiated during surveys unless the survey occurs above a known barrier to anadromous access.

Knownothing Creek is considered to be suitable steelhead habitat from mouth to the confluence with East and West forks (~2.5 miles); and further ~1.5 miles on both forks. Rainbow trout extend further up the Knownothing Creek drainage. Snorkeling associated with habitat surveys noted presence of steelhead/rainbow trout juveniles in 1988, 1989, 1992, and 1998. Additional surveys that observed steelhead/rainbow trout include 1979 and 1982. Juvenile steelhead/rainbow trout were also noted in the vicinity of the mouth during thermal refugia surveys by SRRC in 2005 (SRRC 2005).

Methodist Creek is considered to be suitable steelhead habitat from the mouth to its confluence with Sign Creek (~2.4 miles); and also includes the lower ~0.4 miles of Johnson Creek. Rainbow trout extend further up the Methodist Creek drainage, including the Sign Creek tributary. Snorkeling associated with Forest Service habitat surveys observed juvenile steelhead/rainbow trout in 1988, 1989, and 1992. Thermal refugia surveys by SRRC observed steelhead/rainbow trout juveniles at the mouth and within the stream in 2005 (SRRC 2005). Adult steelhead have been tallied during Fall Chinook spawning surveys since 2010; and in 2011, several fish were reported in Methodist Creek (USFS 2012).

Spawning surveys targeting steelhead have occurred intermittently on both Knownothing and Methodist Creeks since 1980, with redds observed most years that surveys take place (SRRC 2010, 2007; unpub. data).

*CalFish query performed on 2/11/2017

- No live/dead fish nor redd counts available
- Steelhead distribution maps include Knownothing and Methodist Creeks

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Unpublished data and/or field notes from 1982, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1998.

Salmon River Restoration Council (SRRC). 2010. Salmon River community weak stocks assessment program – 2008: August 27, 2008 through March 31, 2010. Draft Final Report. Agreement #P071030200. Prepared for California Department Fish and Game by Salmon River Restoration Council, Sawyers Bar, CA. 23 p + appendices.

Salmon River Restoration Council (SRRC). 2007. Salmon River weak stocks assessment program 2006: June 1, 2006 through September 30, 2007. Final Report. Grant #P04103330. Prepared for California Department Fish and Game by Salmon River Restoration Council, Sawyers Bar, CA. 26 p + appendices.

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

U.S. Forest Service (USFS). 2012. 2011 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 15 p + appendices.

U.S. Forest Service (USFS). 1979. Knownothing Creek – stream survey. Salmon River Ranger District, Klamath National Forest. 4 p + data.

SF Salmon River – Steelhead/Rainbow Trout Surveys

Steelhead/rainbow trout are present in the SF Salmon River in the general project area, with a focus on the reach between Indian Creek and Forks of Salmon (~River mile 7.6 to mile 0). Juvenile steelhead/rainbow trout cannot be visually differentiated.

Steelhead spawning surveys of the SF Salmon River within the Project area have rarely been conducted due to dangerous discharge conditions and poor water visibility present during spring when spawning activity is occurring. Records for the lower (i.e., from mouth to Matthews Creek) SF Salmon River are available for 1989, 1992, and 1995, although specific locations of redds are not recorded. Surveys were conducted from kayak or the road, so it is likely that many redds were missed.

While live adult steelhead may be incidentally reported during Chinook surveys in fall, fish are most routinely observed during the annual spring Chinook/summer steelhead dive event (late-July or early-August), which has occurred since 1990 (most recent report: USFS 2016).

Surveys of thermal refugia and other habitat for juvenile salmonids were conducted on the SF Salmon River in 2005 (SRRC 2005). Steelhead/rainbow trout juveniles have been observed using the thermal refugia zone, else be in the vicinity of the mouth a short distance upstream, of both Knownothing Creek and Methodist Creek.

*Location restricted, where possible, to general Project area (Indian Creek to Forks of Salmon)

*CalFish query performed on 6/6/2016
- See project record for expanded datasets referred in summary
- Steelhead distribution maps include the SF Salmon River in the Project area

Live/Dead Fish Count
- CalFish records available (6): 91038, 91136, 91480, 91481, 91484, 91485
  - Inclusive years (all datasets): 1982, 1990-2013
- Summary: Steelhead recorded in all years within focus reach

Redd Count
- CalFish records available (1): 90720
  - Inclusive years (all datasets): 1989-1993
- Summary: Redds recorded all years
- Note: specific location not provided; only one year (1992) includes the section of river where the Project is located. Other surveys SF Salmon River at or above Cecilville.

Unpublished data and/or field notes from: 1989, 1992, 1995

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

U.S. Forest Service (USFS). 2016. 2016 Spring Chinook/Summer Steelhead dive results. Klamath National Forest Service, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 1 p.

Critical Habitat for Coho Salmon (and) Essential Fish Habitat for Coho/Chinook Salmon

Designated Critical Habitat (CH) for Coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (May 5, 1999, 64 FR 24049). The area described in the final rule represented the current freshwater and estuarine range of Coho salmon. Land ownership patterns within the Coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53% private lands; 36% Federal lands; 10% State and local lands; and 1% Tribal lands. The Forest Service manages about 1,680,000 acres (90.6%) of land within the Forest boundaries and about 200,000 acres (9.4%) of land are within the Forest boundaries but in other ownership (LRMP, Page 3-12). Essential Fish Habitat (EFH) is considered for both Coho and Chinook salmon, with consultation occurring under 305 (b) (4) (A) of the Magnuson-Stevens Fishery Conservation and Management Act. The definition of Coho/Chinook EFH components and extent is described by Amendment 14 (Appendix A, pages 12-35 [adopted year 2000]) of the 1978 Pacific Fisheries Management Council Salmon Fisheries Management Plan.

Conclusions regarding CH and EFH occurrence are based on field review of habitat suitability, professional judgment, District fish survey records, and California Department of Fish and Wildlife (CDFW) information. In general, the KNF Coho Presence (GIS) layer defines CH, and Coho or Chinook distribution (whichever is of maximal extent) defines EFH. As appropriate, the California state information in Calfish.org may also be utilized. Where information on Coho or Chinook is lacking (e.g., no/few surveys have been completed), else it is the professional judgment of the Fish Biologist that neither KNF nor Calfish.org range maps fully capture CH/EFH extent, the KNF Steelhead Trout Distribution (GIS) layer may be used as a proxy for maximum range of anadromous fishes. This dataset is recognized as a conservative approach for assessment of effects to anadromous fish habitat because Coho and Chinook salmon may not occupy the same waters as steelhead due to differences in jumping abilities. The maximum jumping height (under ideal conditions) for Coho is 2.2 meters; Chinook salmon is 2.4 meters; and steelhead is 3.4 meters (Meehan 1991). Therefore, steelhead trout can access more habitat than Coho or Chinook salmon (i.e., steelhead trout can make a 3-meter jump to migrate up a stream, but Coho and Chinook salmon cannot.). Additionally, differences in spawn timing may also affect actual distribution. As an example, steelhead spawn in the spring, encountering higher discharge conditions than Chinook, which spawn in the fall. In consequence, Chinook may be denied access to streams, or segments thereof, due to the presence of low-water barriers that are passible to steelhead during spring flows.

In all cases, field review and site-specific surveys may refine the location of CH or EFH.

Map 3 shows the distribution of CH and EFH the Action Area and Analysis Area. This map is based on fish distribution with site-specific changes made per professional fisheries biologist knowledge, stream surveys, or CDFW data. Field review, survey history, and CalFish.org agree that Coho (for CH/EFH) and Chinook (for EFH) for SF Salmon River in the Project area is appropriately reflected by the existing Forest Service map database.

Lamprey

Pacific Lamprey (*Entosphenus tridentata*)

Pacific lamprey are found in north Pacific coast streams from Japan, through Alaska, and down the North America continent coast, potentially as far as southern California or Baja California (USFWS 2012; Moyle 2002). This species has many derivative forms, including anadromous (the most common), resident, and landlocked; and the relationship between *E. tridentata* and its multiple forms, as well as similar species, is not fully resolved (Moyle 2002). Pacific lamprey is a Sensitive species for the Klamath National Forest.

Pacific lamprey are usually anadromous, with two distinct parts of their complex life cycle. Following is a generalized life cycle description, as summarized from Moyle (2002), Close, *et al*. (2010), and USFWS (2012). After hatching in freshwater in the late spring and early summer, larvae (ammocoetes) leave the nest and passively drift until suitable substrate – sand/silt – is encountered. Once a site is colonized, the blind larvae filter feed upon detritus for an extended period of time. Length of in-stream residence is uncertain, an individual may retain a larval form between three to seven years, with four to six years typical. Time to metamorphosis is dependent upon how long it takes to grow to a particular size. At 14-16 centimeter total length, larvae begin metamorphosis to the ocean-going adult form. Metamorphosis occurs over multiple months, and requires physiological changes from sessile filter-feeder to active predator, including changes in sensory system (such as growing eyes), digestive system, and tolerance to sea water. Downstream migration appears correlated with high flow events of winter and spring. Adults spend up to four years in the ocean where feeding is by parasitism: an individual latches to its prey (usually fish, but sometimes marine mammals), rasps a hole through the skin, extracts body fluids and flesh, and finally drops off once full. Upmigration from the ocean occurs from winter through early summer, although lamprey may hold in a river up to a year before the final migration into spawning streams. Once the spawning migration starts, lamprey stop eating. Pacific lamprey do not appear to home to a natal stream, instead following the smell of pheromones produced by ammocoetes to find suitable spawning habitat. In late spring through early summer, nests are constructed, and while some adults may survive to return to the ocean, most die soon after spawning.

Specifics of the general Pacific lamprey life cycle as applied to the Klamath River system, much less its individual tributaries, are largely uncertain. Initial movement of spawners from the ocean into the river may occur at any time of the year, but is primarily late winter and into spring (Larson and Belchik 1998, Close, *et al*. 2010). Additionally, there is evidence of at least two distinct runs: a spring run that spawns shortly after entering freshwater, and a fall run that holds over and spawns the following spring (Anglin 1994). Downstream emigration of lamprey occurs year-round, with final outmigration to saltwater of transformed adults in late fall through spring (Anglin 1994; Close, *et al*. 2010). Other particulars, such as details about the ammocoete stage and spawning specifics (i.e., months, locations) for the various Klamath River tributaries, are unknown.

Habitat for Pacific lamprey ammocoetes is very important due to the long in-stream residence. Sands and silts are the preferred habitat of larvae, with larger substrate sizes utilized by larger (older) individuals (Sugiyama and Goto 2002; Stone and Barndt 2005). Finer particles are endemic of lower velocity environments such as stream margins, backwaters, eddies, and pools. Although ammocoetes are often considered to be sedentary, they will actively seek new habitat if a particular site becomes unsuitable (Moyle 2002; USFWS 2010). Most important is that the stream velocity has to be fast enough to allow filter feeding, yet sufficiently slow to retain the preferred sediments (Torgensen and Close 2004). For poorly known reasons, distribution of lamprey larvae in a stream tends to be patchy – not all suitable habitats are utilized – but it may be a function of microhabitat, variation between stream reaches, and seasonal movement to take advantage of different habitat (Sugiyama and Goto 2002; Torgensen and Close 2004). Optimal temperature requirements for ammocoetes, as well as other water quality parameters, needs further study. However, it is known that eggs will successfully hatch from 10° to 22°C, with highest survival 10° to 18°C; and that local spawning peaks are likely tied with water temperatures most advantageous for embryo development (Meeuwig, *et al*. 2005).

Pacific lamprey spawning habitat is very similar to that required by salmonids. Redds are generally built in gravel and cobble substrates, with moderate velocity flowing water. Of the 125 Pacific lamprey nests surveyed in the Smith River, Oregon, most were observed in low gradient riffles, pool tailouts and lateral scour pools (Gunckel, *et al*. 2009). Most of these nests were associated with cover, including gravel and cobble substrates, vegetation and woody debris. Likewise, nests observed elsewhere have also largely associated with pool-tail outs, low gradient riffles and runs, including Cedar Creek, Washington (Stone 2006) and various tributaries within the Willamette River basin, Oregon (Mayfield, *et al*. 2014). Spawning activity has been observed to commence in association with the descending limb of the spring hydrograph once water temperature exceeds 10ºC, and be at its most intense between 10ºC and 15ºC (Mayfield, *et al*. 2014). Upstream extent of spawning Pacific lamprey is often considered synonymous with salmonid anadromy, although there are indications that this assumption may not always be true – under natural conditions, lamprey may be able to pass traditional barriers to upmigrating steelhead and salmon, such as waterfalls (USFWS 2012). Research is on-going on this topic. Until consensus is reached within the scientific community, it is appropriate to continue to utilize salmonid anadromy as Pacific lamprey extent.

Pacific lamprey numbers in the Klamath River appear to be decreasing. While there is no estimate of the current population, oral history taken from tribal fishers indicates a long-term decline in adult catch (Larson and Belchik 1998; USFWS 2012). A downward trend is suggested for outmigrating juveniles caught in rotary screw traps in the Klamath River basin between 1997 and 2004 (USFWS 2004). The Scott River and Shasta River rotary screw trap datasets (2001-2015) also exhibit long-term declines (B. Chesney, pers. comm.)

Klamath River Lamprey (*Entosphenus similis*)

Klamath River lamprey are found in the upper and lower Klamath River system, including its tributaries (Moyle 2002). This species is non-migratory and can be found within both rivers and lakes (Moyle 2002; CWS 2013). Klamath River lamprey is a Sensitive species for the Klamath National Forest.

Specifics concerning the life history and habitat needs of the Klamath River lamprey are few, but it is presumed to be broadly similar to the Pacific lamprey. One primary difference is that this species is limited to freshwater (i.e., is not anadromous), and therefore adults feed on prey such as salmonids, suckers, and cyprinids throughout their life (Moyle 2002; CWS 2013). Downstream of Iron Gate Dam, the distribution of Klamath River lamprey is presumed to be similar to anadromous salmonids, its primary food source (CWS 2013).

All Locations – Lamprey Surveys

Understanding of the full extent of distribution of Sensitive lamprey species within Project area waterways is unknown.

Rearing for *Entosphenus ssp*. has been documented in the Salmon River drainage. As it is not possible at this time to tell apart live Pacific lamprey and Klamath River lamprey under field conditions, the proportions and specific locations where each may be found is unknown. Lamprey of an appropriate age/size to be distinguished to species (e.g., Pacific lamprey) have been captured in the Karuk rotary screw trap located near the mouth (Karuk 2013). However, as the trap is a passive capture device of drifting organisms, it is not possible to determine origination other than "Salmon River drainage." More recently, ammocoete surveys (*Entosphenus ssp*.) were conducted in the Salmon River drainage, with positive observations made at multiple locations on SF Salmon River from Forks of Salmon to about 1 mile downstream of the Petersburg Guard Station (USFS 2016).

A combination of relatively small drainage size, moderate to high gradient channel slopes, patchy fine sediment distribution, and limited organic matter are associated with the underlying reason regarding absence of lamprey rearing in some Salmon River tributaries. Knownothing and Methodist Creeks are considered to contain minimal, at best, rearing habitat for lamprey, and ammocoetes were not detected in either creek during recent surveys in the Salmon River drainage (USFS 2016). While it is unlikely that larval lamprey are present in either tributary, spawning habitat for adults may be present, but further evaluations are needed.

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Appendix B: Table of Pathway and Indicators

Klamath National Forest Matrix: Table of Population and Habitat Indicators for Use on the Klamath National Forest in the Northwest Forest Plan Area

Aquatic Habitat Conditions Analysis Guidelines

AP = Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area (USDI, USDA, and NOAA 2004).
Available at www.blm.gov/or/esa/reports/Analytical_Process_110504.doc.

The table(s) within this Appendix show criteria used to determine baseline conditions in 7th-and 5th-field watersheds within the KNF boundaries **that contain anadromous fish habitat**. The criteria in the Table and footnotes are used to describe the current condition of Klamath Mountains watersheds, and to determine if projects are likely to affect anadromous salmonids via effects on salmonid habitat components. Current conditions of watershed(s) are assessed and documented in the Table of Habitat Indicators; and effects to Indicators from proposed actions are discussed in the narrative within the BA/BE and summarized in the Table of Habitat Indicators.

The initial KNF-NMFS Level 1 review of the Table criteria was completed by Perrochet, Thomas, and Flickinger in April 2007. Edits to LWD were made in March 2009 to reflect LRMP EIS values. The Table was updated in 2004 as part of the Analytical Process for ESA consultation with NMFS. In May 2012 Grunbaum and Meneks provided updates/edits to this document and the Table of Habitat Indicators.

The Table, as designed in the 2004 Analytical Process, and in earlier versions (1997 NMFS BO for the LRMP), suggests values to determine a level of functioning for anadromous fish bearing streams. A note about rigid values to assess level of functioning: in addition to fixed habitat parameters not allowing for natural variability, fixed habitat parameters set standards that may be geomorphically inappropriate (Bisson et al. 1997). Variability is an inherent property of aquatic ecosystems in the Pacific Northwest and habitats at any given location will change from year to year, decade to decade, and century to century (Bisson et al. 1997). Healthy lotic ecosystems require different parts of the channel system to exhibit very different in-channel conditions and that those conditions change through time (Reid and Furniss 1998). Also, data may not be available for the stream being assessed. Therefore, a conclusion of function must be evaluated with professional judgment recognizing the streams capability to perform within rigid values. In some cases, a stream’s morphology, aspect or size may not support “Properly Functioning” criteria values for one or more habitat Indicators. If an Indicator for a particular stream is determined to be functioning at its capability (due to morphology, aspect, or size), it is rated as Properly Functioning even if it doesn’t meet Table criteria values. In the absence of available data, table and associated footnotes suggest factors that should be considered when evaluating indicators.

Klamath National Forest Tributaries Table of Pathways and Indicators

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat: Non Watershed Condition Indicators				
Water Quality:	Temperature (1)			
	1st - 3rd Order Streams [instantaneous]	69 F degrees (~ 20.5 C) or less	> 69 to 70.5 degrees F	70.5 F degrees (~ 21.3 C) or more
	4th-5th Order Streams [Maximum Weekly Maximum Temperature]	70.5 F degrees (~ 21.4 C) or less	> 70.5 to 73.5 degrees F	73.5 F degrees (~ 23.0 C) or more
	Suspended Sediment/Turbidity	Little to no quantitative turbidity data exists for streams on the Klamath National Forest. Use the following criteria to infer condition of turbidity Indicator: (1) professional judgment from years of direct observation of tributary streams; (2) amount of fines in substrate from stream survey data, (3) CWE modeled level of watershed surface erosion and mass wasting, and (4) condition of stream buffer RR and channel (particularly if there has been recent debris flows that altered the channel). Professional judgment of turbidity is based on observations of water clarity after peak flows in tributaries to the mainstems of the Klamath, Scott, and Salmon Rivers that have watersheds with varying degrees of disturbance from nearly pristine to highly disturbed. Properly Functioning: Water clarity returns quickly (within three days) following peak flows.	Water clarity slow (four to six days) to return following peak flows, moderate to high fines in substrate, moderate modeled surface erosion and mass wasting, and riparian reserves are not fully functioning.	Water clarity poor for long periods of time (one week or more) following peak flows. Some suspended sediments occur even at low flows or base flow. High fines in substrate, stream buffers in poor condition, high modeled surface erosion and mass wasting, and riparian reserves are in poor condition.
	Chemical/Nutrient Contamination (2)	Scott, Salmon, and Klamath River mainstems: Low levels of contamination from agriculture, industrial, and other sources; no excess nutrients. No CWA 303d designated reaches. Scott, Salmon, and Klamath River tributaries: None or low levels of chemical and/or nutrient contamination from agriculture, industrial, and other sources; no excess nutrients.	Scott, Salmon, and Klamath River mainstems: Moderate levels of contamination from agriculture, industrial, and other sources; some excess nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: Moderate levels of contamination from agriculture, industrial, and other sources and/or moderate excess nutrients.	Scott, Salmon, and Klamath Rivers: mainstems: High levels of contamination from agriculture, industrial, and other sources; high levels of nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: High levels of contamination from agriculture, industrial, and other sources and/or moderate to high excess nutrients.
Habitat Access:	Physical Barriers (AP)	Any man-made barriers present in watershed allow upstream and downstream passage at all flows.	One or more human -made barriers present in watershed do not allow upstream and/or downstream passage at base/low flows.	Human-made barriers present in watershed do not allow upstream and/or downstream passage at a range of flows for at least one life history stage.

Klamath National Forest Tributaries Table of Pathways and Indicators:

Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Substrate character [3]	Use stream survey data for determining substrate character. In addition, use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat. Can also infer substrate character functioning level from other factors such as high road density and hydrologic connection, recent large intense wildfires, and recent (last 20 years) altered channel.		
Habitat Elements:		Less than 15% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness less than 20%. Additional desired conditions, as per TMDL/NCRWB water quality compliance, include: *Pool sediment vol (V*): ≤21% *Subsurface, <0.85 mm: ≤14% *Subsurface, <6.4 mm: ≤30%	15% or greater fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and/or cobble embeddedness is 20% or greater.	Greater than 20% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness greater than 25%.
	Large Woody Debris [4]	See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.	Current levels are being maintained at minimum levels desired for "properly functioning" but potential sources for long term woody debris recruitment are lacking to maintain these minimum values.	Current levels are not at those desired levels for "properly functioning" and potential sources of woody debris for short and/or long term recruitment are lacking.
	Pool Quality and Frequency [5]	At least one primary pool every three to seven bankfull channel widths. In 1st through 3rd order streams, a primary pool must have a maximum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a maximum depth of three feet or greater. In 6th order and larger streams, a primary pool must have a maximum depth of four feet or greater.	At least one pool every three to seven bankfull channel widths. At least half of the pools are primary pools. At least half the pools have a maximum depth of at least 24 inches (1st- 3rd order streams) or 36 inches (4th order and greater).	There is less than one pool every three to seven bankfull channel widths and/or less than half the pools have maximum depth of at least 24 inches (1st-3rd order streams) or 36 inches (4th order and greater).
	Off-Channel Habitat	Fish have unrestricted access to off-channel habitats (such as oxbows, off-channel ponds, backwaters, and areas of low flow velocity and cover) in unconstrained reaches during high flows and flooding events in winter. And these off-channel areas are relatively undisturbed by dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats, and the quantity and quality of off-channel habitats, in unconstrained reaches, is diminished due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats in unconstrained reaches is severely restricted or impossible due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, etc., and/or the quality of the off-channel habitats is poor due to vegetation clearing, wood removal, poor water quality, and the other factors listed above. .

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat Elements:	Refugia (important remnant habitat for sensitive aquatic species)	Critical habitats necessary for successful completion of all anadromous salmonid life history phases (spawning, incubation, emergence, freshwater rearing, and migration) are functioning, accessible, and well-distributed. Critical summer refugia in Klamath Mountain streams include: (1) thermal refugia and (2) anadromous stream reaches with intact riparian reserves, cool clean water, pools that are not filled-in or partially filled-in with excess sediment, adequate stream flows, and good water quality. Critical winter habitat for anadromous salmonids includes side channels, off-channel habitats, and floodplain habitats.	Not all critical habitats necessary for successful completion of all anadromous salmonid life history phases are functioning and/or accessible for salmonids and/or well-distributed. Habitat quality and/or accessibility is diminished due to dikes, levees, dredge tailings, other fills, roads, excavations, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Many of the critical habitats necessary for successful completion of all anadromous salmonid life history phases are not functioning and/or not accessible for salmonids, and are thus are poorly distributed across the stream network and not providing adequate biological connectivity.
Channel Condition and Dynamics:	Width/Depth Ratio **(6)**	Width-to-Depth ratio < 12 on all reaches that could otherwise best be described as 'A', 'G', and 'E' channel types. Width-to-Depth ratio > 12 on all reaches that could otherwise best be described as 'B', 'F', and 'C' channel types. No braided streams formed due to excessive sediment loads. Lacking data, width-to-depth ratio should be evaluated considering the following factors: (1) recent (last 20 years) history of debris flows that have scoured channel and resulted in aggradation or degradation of the stream bed, (2) recent history of mass wasting that delivered large volumes of sediment to the stream that may have filled in pools, (3) pool frequency and depth information from stream surveys, (4) watershed disturbance as estimated with CWE modeling for mass wasting (GEO) and peak flows (ERA/TOC), and (5) frequency of large woody debris in the stream channel. For properly functioning, stream crossing density is low, there have been few mass wasting events caused by management actions, there are numerous deep pools, modeled mass wasting and surface erosion is low, and there is adequate LWD. If there is no or little management disturbance legacy in a watershed, then width-to-depth ratio is assumed to be properly functioning.	More than 10% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in some alluvial reaches as a result of excessive aggradation due to high sediment loads. For at-risk, stream crossing density is moderate to high, there have been some mass wasting events caused by management actions, pool frequency and quality is at-risk, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.	More than 25% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in many alluvial reaches as a result of excessive aggradation due to high sediment loads. For not properly functioning, stream crossing density is high, there have been some large mass wasting events caused by management actions, pool frequency and quality is poor, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Streambank Condition (AP)	> 80% of any stream reach has ≥ 90% stability. Most watersheds have no bank stability surveys data so the level of streambank stability should be evaluated by considering: (1) density of road-stream crossings per stream or stream reach, (2) amount of inner gorge road, (3) other clearing and/or compaction directly adjacent to the stream, (4) artificial banks created by pushing up berms, and (5) recent (since 1996) channel altering debris flows. For properly functioning: Stream crossing density is low to moderate, there is little to no inner gorge road, there is no or only minor disturbance next to the stream channel, there are few or no berms, dikes, or levees constraining the channel, and/or there has been no or minor channel alteration/filling due to debris flows/landslides related to past management actions.	50-80% of any stream reach has ≥ 90% stability. For at-risk: Stream crossing density is moderate to high, there is some inner gorge road, there is some disturbance next to the stream channel, there are some berms, dikes, or levees constraining the channel, and/or there has been some channel alteration/filling due to debris flows/landslides related to past management actions.	< 50% of any stream reach has ≥90% stability For not properly functioning: Stream crossing density is high, there is over a mile of inner gorge road, there is significant disturbance next to the stream channel, berms, dikes, or levees constrain over a mile of channel; and/or there has been significant channel alteration/filling due to debris flows/landslides related to past management actions.
	Floodplain Connectivity (AP)	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation, and succession.	Reduced linkage of wetland, floodplains, and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland area drastically reduced and riparian vegetation/succession altered significantly.
Flow / Hydrology:	Change in Peak/Base Flows [7]	Properly functioning watersheds for peak flow have low modeled ERA/TOC, low road density, few large clearings in the rain-snow transition zone, and vegetation close to reference condition. Properly functioning watersheds for base flow have low modeled ERA/TOC, low road density and hydrologic connectivity, and vegetation close to reference condition.	Watersheds at-risk for change in peak flow have moderately high to high modeled ERA/TOC, moderate to high road density, and/or some large recent clearings in the rain-snow transition zone. Watersheds at-risk for change in base flow have denser vegetation compared to reference conditions, several water diversions, and moderate density of roads that have hydrologic connectivity.	Watersheds not properly functioning or change in peak flow have high modeled ERA/TOC, high road density, and may have large recent clearings in the rain-snow transition zone. Watersheds not properly functioning for change in base flow have much denser vegetation compared to reference conditions, numerous or large water diversions, and high density of roads that have hydrologic connectivity.

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Increase in Drainage Network (AP)	Zero or minimum increases in active channel length correlated with human caused disturbance (e.g., trails, ditches, compaction, impervious surface, etc). The primary cause of drainage network increase in Klamath Mountain watersheds is hydrologic connectivity between the road system and the stream network.	Low to Moderate increases in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc).	Greater than moderate increase in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc).
Watershed Condition <u>Indicators</u>				
Watershed Conditions:	Road Density and Location (AP)	Less than 2 miles per square mile.	Two to three miles per square mile.	Over 3 miles per square mile.
	Riparian Reserves – NW Forest Plan (AP) [8]	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (> 80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition > 50%.	Moderate loss of connectivity or function (shade, LWD recruitment, etc) of riparian reserve system, or incomplete protection of habitat and refugia for sensitive aquatic species (approx. 70-80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better. Some past stand-replacement timber harvest or intense fire in RR, moderate road and landing density in RR, minor to moderate level of mining in RR, vegetation/fuels moderately departed from historic fuels conditions, species diversity and vegetation structure in stream buffers moderately altered from reference condition due to fire suppression and past timber harvest, and moderate modeled CWE values.	Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitat and refugia for sensitive aquatic species (approx. less than 70% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition is 25% or less. Extensive past stand-replacement timber harvest or intense fire in RR, high road and landing density in RR, moderate to high intensity of mining in RR, vegetation/fuels greatly departed from historic fuels conditions, species diversity and vegetation structure in stream buffers significantly altered from reference condition due to fire suppression and past timber harvest, and high modeled CWE values.

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Disturbance History/Regime	Frequency, duration, and magnitude of stochastic disturbance events are close to reference condition. The following factors should be considered in rating the Watershed Disturbance/Regime indicators: (1) overall watershed disturbance as determined through CWE modeling, (2) road density and location, (3) current impacts from past stand-replacing forestry, mining, and intense fires, (4) departure from historic fire regime, (5) departure from historic vegetation structure and composition, and (6) character of development on private property. For properly functioning, a watershed should have low CWE and road density (all models under "1" threshold), few impacts from past stand-replacement forestry or intense fire, are not significantly departed from historic vegetation/fuels condition and fire regime, and/or have low disturbance on private property.	In at-risk watersheds, frequency, duration, and magnitude of stochastic disturbance events are moderately departed from reference condition. At-risk watersheds have moderate to high CWE and road density (one or two models over "1" threshold), some significant impacts from past stand-replacement forestry or intense fire, are moderately departed from historic vegetation/fuels condition and fire regime, and/or have moderate disturbance on private property.	In not properly functioning watersheds, frequency, duration, and magnitude of stochastic disturbance event is significantly departed from reference condition. Not properly functioning watersheds have high CWE and road density (all models over "1" threshold), significant impacts from past stand-replacement forestry or intense fire, are significantly departed from historic vegetation/fuels condition and fire regime, and/or have significant disturbance on private properties.
Summary Integration of all species and habitat indicators effects	How do the effects to indicators affect each fish species and their habitat? Describe by species and by 7th and 5th field watersheds. See AP guidance. In addition to the narrative summary, use Summary Table in Tables required for BA/BE.			

Footnotes to Table Above: *Table of Population and Habitat Indicators For Use on the Klamath National Forest in the Northwest Forest Plan Area, as adjusted from Appendix A in the Analytical Process*.

1) (Temperature) Proper Functioning criteria for 4th -5th Order streams is derived from temperature monitoring near the mouth of streams of relatively undisturbed watersheds (Clear, Dillon, and Wooley Creeks). –Maximum Weekly Maximum Temperatures (MWMT) as high as 70.5 degrees F have been recorded on these streams (EA Engineering, 1998 Salmon River and Dillon Creek Watershed Fish Habitat and Channel Type Analysis, Appendix 2). At-Risk criteria for 4th/5th order streams is derived from monitoring in streams that support populations of anadromous fish, although temperatures in this range (70.5 to 73.5 degrees F) are considered sub-optimal. The Not Properly Functioning criterion is sustained temperatures above 73.5 degrees F - that causes cessation of growth and approach lethal temperatures for salmon and steelhead. Properly Functioning criteria for 1st - 3rd order streams is derived from Desired Future Conditions (DFC) values given in the LRMP EIS p 3-68. At Risk and Not Properly Functioning criteria for 1st – 3rd order streams are assigned on a temperature continuum with values given for 4th/5th order streams, with the maximum instantaneous temperature of At Risk 1st - 3rd order streams coinciding with the minimum MWMT of 4th/5th order At Risk streams. [Stream Order according to Strahler (1957).]

(2) (Chemical/Nutrient Contamination) For projects within the river corridors of the mainstem Scott, Salmon, and Klamath Rivers the criteria is unchanged from AP Table. For tributaries to the Scott, Salmon, and Klamath Rivers use the criteria from the AP table. Although these tributaries have CWA 303d designation, Klamath National Forest tributaries are typically properly functioning for dissolved oxygen, nutrients, and microcystin, and because temperature and sediment is assessed in the Temperature and Substrate Character Indicators. Chemical contamination and nutrients should be assessed for Scott, Salmon, and Klamath River tributaries.

(3) (Substrate Character) Use recent stream survey data where available. Properly Functioning criteria for % fines in gravel is from the LRMP EIS p 3-68. Additional Forest-wide desired conditions for sediment (pool sediment, subsurface sediment) are described by Laurie and Elder (2012) in relation to monitoring for TMDL and NCRWB water quality standards. When location-specific information is unavailable, use the following as best appropriate: use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat, infer substrate character functioning level from other factors such as high road density and degree of hydrologic connection, recent large intense wildfires, and recent (last 20 years) debris flows that altered channels, and lastly use professional judgment to describe existing conditions and to estimate effects based upon model output interpretation, research results, or other information. The KNF CWE modeling procedure describes the risk (probability) of project-caused sediment production (see 2004 CWE process paper, by Elder and Reichert, in fisheries sufficiency guides). For existing condition and effects of the action:

1. Properly Functioning: USLE and GEO values are less than 1.0
2. At Risk: USLE and GEO values are between 1.0-1.20
3. Not Properly Functioning: USLE and GEO values are greater than 1.20

(4) (Large Woody Debris) See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.

Criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width. Stable pieces of woody debris remain stationary during normal to high flows. Channel width and depth largely determines whether large woody debris recruited into a stream reach will be stable, and largely determines the average size of wood retained in streams (Bilby and Ward 1989, 1991; Robison and Beschta 1990). As channels become wider and deeper, the average size of a stable piece of wood increases. Pieces shorter than bankfull width and with a diameter less than bankfull depth are more likely to be transported out of a reach by streamflow (Bilby 1984, Braudrick et al. 1997). Length of woody debris appears to be most important to its stability where stream discharge is sufficient to float large diameter stems (Bilby 1985, Swanson and others 1984). Branches and/or rootwads, if still attached, add to the stability of woody debris. Therefore, criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width.

(5) (Pool Quality and Frequency) A measurable pool is an area of channel which (1) shows clear signs that the pool was created by scour at high flows and/or that the pool is the result of the channel being dammed at the downstream end; (2) has a significant residual depth - the deepest part of the pool must be at least twice as deep as the water flowing out of the pool at the riffle crest; (3) has an essentially flat water surface during low flow - water surface slope <0.05 percent; and (4) includes most of the channel - it must include the thalweg and occupy at least half of the width of the low-flow channel. “Primary” pools are defined by their maximum depth in relationship to size or stream order. As the order or size of the stream increases the required minimum depth for a primary pool increases. In 1st through 3rd order streams, a primary pool must have a minimum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a minimum depth of three feet. In 6th order and larger streams, a primary pool must have a minimum depth of four feet.

(6) (Width/Depth Ratio) The Width-to-Depth ratio for various channel types is based on delineative criteria of Rosgen (1996). Properly Functioning means that Width-to-Depth ratio falls within expected channel type as determined by the other four delineative factors (entrenchment, sinuosity, slope, and substrate). Aggradation on alluvial flats causing braiding is well known phenomenon that often accompanies changes in Width-to-Depth ratio as watershed condition deteriorates. Stream width is a function of streamflow occurrence and magnitude, size and type of transported sediment, and the bed and bank materials of the channel (Rosgen 1996). Channel widths generally increase with flow volume downstream. Channel widths can be modified by changes in riparian vegetation, landslides particularly debris flows, changes in streamflow regimes, and changes in sediment supply. The AP Table indicates that confined or entrenched channel types (such as A, G, and E types) are Properly Functioning when Width-to-Depth ratios are <12, and wider channel types (such as B, C, and F types) are Properly Functioning when Width-to-Depth ratios are >12. To meet the Properly Functioning criteria channels must also have no or minimal braiding due to excessive sediment.

(7) (Peak/Base Flows) In most cases, sufficient hydrograph data is not available to determine comparative changes in peak flows as suggested in the AP. Infer changes in **peak flows** when no hydrograph data is available by considering the following factors: (1) CWE runoff model (ERA/TOC) outputs, (2) road density and the degree of hydrologic connectivity between the road system and the stream network, and (3) number, size, and vintage of openings in the forest canopy resulting from past stand-replacement forestry in the snow-rain transition zone where increased openings can result in elevated runoff from rain-on-snow events. The potential for decreased **base flows** in the Project HUC7 watersheds should be evaluated by considering the following factors: (1) increased/decreased evapotranspiration due to denser/sparser vegetation than reference condition that has resulted from stand-replacement forestry and/or fire suppression, (2) number and size of water diversions, and (3) degree of hydrologic connectivity between the road system and the stream network (watersheds with high road density likely have reduced base flows due to impervious surfaces and groundwater interception in road cuts).

(8) (Riparian Reserves) The following factors should be considered in determining the condition of stream buffer (hydrologic) RR: (1) amount and age of past stand-replacement forestry or intense fire in stream buffers, (2) road and landing density in stream buffers, (3) mining in stream buffers, (4) departure from historic fire regime, (5) condition of riparian vegetation for providing shade, large woody debris, sediment-filtering, and nutrient cycling, and (6) the amount of overall disturbance in the watershed particularly as estimated by the peak flow (ERA) and mass wasting (GEO) models. The following two factors should be considered in determining the condition of geologic RR: (1) amount and age of past stand-replacement timber harvest and/or recent intense wildfire on geologic RR and (2) road and landing density on geologic RR.

Appendix C: Environmental Baseline and Proposed Effects Checklist

Checklists for documenting environmental baseline and effects of proposed actions(s) on relevant indicators for

South Fork Tributary Habitat Enhancement Project

Legend For Reference Information Used to Determine Baseline Conditions:

ND: No data
N/A: Not applicable
PJ-MM: Professional judgment (M. Meneks – KNF District Fish Biologist)
PJ-AF: Professional judgement (A. Fingerle – Independent Aquatic Biologist)
Quiñones 2011: Recovery of Pacific Salmonids in the Face of Climate Change: A Case Study of the Klamath River Basin, California [PhD Thesis] (Quiñones 2011)
Siskiyou 2002: Siskiyou County Culvert Inventory and Fish Passage Assessment (Taylor, et al. 2002)
SRCA 1998: Salmon River and Dillon Creek Watersheds Fish Habitat and Channel Type Analysis (USFS 1998)
Coho-Sal 2014: SONCC Coho Recovery Plan, Chapter 35 – Salmon River (NOAA 2014)
WA 1997: Lower South Fork Salmon River Ecosystem Analysis (USFS 1997)
WA 1994: Upper South Fork Salmon River Ecosystem Analysis (USFS 1994)

CDFW 2017: Passage assessment database query
FishPass 2001: Regional Fish Passage Assessment, 2001

CWE: CWE data by watershed (see Table 3 in document text)
Sed 2016: Sediment monitoring, KNF – 2009 to 2015 (USFS 2016)

SRRC 2014: Knownothing Creek/Methodist Creek channel assessment and large woody debris inventory (unpub. data)
KC 1998: Knownothing Creek survey data – 1998 (unpub. data)
KC 1989: Knownothing Creek survey data – 1989 (unpub. data)
KC-Sed: Knownothing Creek substrate survey data – 1990-1992 (unpub. data)
MC 1992: Methodist Creek survey data – 1992 (unpub. data)
MC 1989: Methodist Creek survey data – 1989 (unpub. data)
MC 1988: Methodist Creek survey data – 1988 (unpub. data)
MC-Sed: Methodist Creek substrate survey data – 1990-1992 (unpub. data)

Temps-KC: Summer temperature data (2010-2015) – Knownothing Creek
Temps-MC: Summer temperature data (2010-2015) – Methodist Creek
Temps-SFSal: Summer temperature data (2010-2015) – SF Salmon River
WQ 2012: Stream temperature monitoring, KNF – 2010 and 2011 (USFS 2012)

CA-EPA: http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/303d/

Table of Pathway and Indicators for 7th Field Watersheds:
Lower Knownothing Creek (for Knownothing Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	**FUNCTIONING - AT RISK**	**NOT PROP. FUNCT.**	**RESTORE**	**MAINTAIN**	**DEGRADE**
HABITAT:						
Habitat Quality Temperature		Temps-KC; WQ 2012			X	
Suspended Sediment – Intergravel DO/Turbidity	PJ-MM; PJ-AF; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	CA-EPA				X	
Habitat Access Physical Barriers		PJ-MM[1]			X	
Habitat Elements Substrate Character and Embeddedness	PJ-MM; Sed 2016; KC 1989, 1998; KC-Sed			<== X		
Large Woody Debris			SRRC 2014; WA 1997; SRCA 1998; KC 1998	<== X		
Pool Frequency and Quality			PJ-MM; KC 1989, 1998	<== X		
Large Pools						
Off-channel Habitat	ND – presumed minimal in extent. Where most probable to be present in lowermost drainage, likely At-Risk due to historic mining activity (PJ-MM)				X	
Refugia		PJ-AF			X	
Channel Cond & Dyn Average Width/Maximum Depth	PJ-AF; SRRC 2014; KC 1989, 1998				X	
Streambank Condition	ND – while stability may visually appear “good”, the streambank is departed from historic conditions due to legacy mining activity (PJ-AF)				X	
Floodplain Connectivity	ND – expectation in Project area is At-Risk due to historic mining activity (PJ-MM)				X	
Flow/Hydrology Change in Peak/Base Flows	PJ-MM; CWE				X	
Increase in Drainage Network		PJ-MM			X	
Watershed Conditions Road Density & Location		GIS			X	
Disturbance History & Regime		PJ-MM; WA 1997			X	
Riparian Reserves – Northwest Forest Plan		PJ-MM; Coho-Sal 2014; WA 1997			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X		<== X		
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. and Table 5 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1] An old (unused) diversion dam is present on Knownothing Creek, but not reflected in the CDFW passage database or other documentation

Table of Pathway and Indicators for 7th Field Watersheds:
Methodist Creek (for Methodist Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature		Temps-MC; WQ 2012			X	
Suspended Sediment – Intergravel DO/Turbidity	PJ-MM; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	CA-EPA				X	
Habitat Access Physical Barriers	CDFW 2017; Siskiyou 2002; Fishpass 2001				X	
Habitat Elements Substrate Character and Embeddedness		PJ-MM; Sed 2016; MC-Sed		<== X		
Large Woody Debris			SRRC 2014; SCRA 1998; WA 1997; MC 1992	<== X		
Pool Frequency and Quality			PJ-MM; MC 1988, 1989, 1992	<== X		
Large Pools						
Off-channel Habitat	ND – presumed minimal in extent. Where most probable to be present in lowermost drainage, likely FAR due to legacy mine berms (PJ-MM)				X	
Refugia		PJ-AF			X	
Channel Cond & Dyn Average Width/Maximum Depth	PJ-AF; SRRC 2014				X	
Streambank Condition	ND – while stability may visually appear "good", the streambank is departed from historic conditions due to legacy mining activity (PJ-AF)				X	
Floodplain Connectivity	ND – expectation in Project area is At-Risk due to historic mining activity (PJ-MM)				X	
Flow/Hydrology Change in Peak/Base Flows	PJ-MM; CWE				X	
Increase in Drainage Network		PJ-MM			X	
Watershed Conditions Road Density & Location		GIS			X	
Disturbance History & Regime		PJ-MM; WA 1997			X	
Riparian Reserves – Northwest Forest Plan		PJ-MM; Coho-Sal 2014; WA 1997			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X		<== X		
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. and Table 5 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

Table of Pathway and Indicators for 5th Field Watershed:
South Fork Salmon River (for mainstem SF Salmon River)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature			Temps-SFSal; Coho-Sal 2014; SRCA 1998; WA 1997, 1994		X	
Suspended Sediment – Intergravel DO/Turbidity		PJ-MM; WA 1997, 1994			X	
Chemical Contamination/ Nutrients	CA-EPA				X	
Habitat Access Physical Barriers	CDFW 2017; Coho-Sal 2014; Siskiyou 2002; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness		SRCA 1998; WA 1997, 1994			X	
Large Woody Debris			Coho-Sal 2014; SRCA 1998; WA 1997, 1994		X	
Pool Frequency and Quality		SRCA 1998; WA 1997, 1994			X	
Large Pools						
Off-channel Habitat		PJ-MM; Coho-Sal 2014			X	
Refugia	PJ-MM				X	
Channel Cond & Dyn Average Width/Maximum Depth	PJ-MM; CWE				X	
Streambank Condition	ND – likely Properly Functioning (PJ-MM)				X	
Floodplain Connectivity	PJ-MM; Coho-Sal 2014				X	
Flow/Hydrology Change in Peak/Base Flows	PJ-MM; CWE; Coho-Sal 2014				X	
Increase in Drainage Network	PJ-MM; CWE				X	
Watershed Conditions Road Density & Location	CWE; SRSS 2002				X	
Disturbance History & Regime		PJ-MM; Coho-Sal 2014; WA 1997, 1994			X	
Riparian Reserves - Northwest Forest Plan		PJ-MM; Coho-Sal 2014; WA 1997, 1994			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. and Table 5 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

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